Engineering Library

The Engineer.

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VOL. CL.—No. 3900] LONDON: FRIDAY EVENING, OCTOBER 10, 1930 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

The Director-General, India Store Department, Belvedere-road, Lambeth, London, S.E. 1, invites TENDERS for—
THIRTEEN LOCOMOTIVES, Type YC, metre gauge.
Tenders due 31st October, 1930.
Forms of Tender available from the above at a fee of 5s., which will not be returned. 5918

Indian Service of Engineers and Indian Railway Service of Engineers.
The Secretary of State for India in Council will, in the near future, APPOINT FIVE ASSISTANT EXECUTIVE ENGINEERS (including, if possible, one Burman, who will be appointed to the India recruited branch in Burma) to the INDIAN SERVICE of ENGINEERS, and TWO ASSISTANT EXECUTIVE ENGINEERS to the INDIAN RAILWAY SERVICE of ENGINEERS. Except for the Burman appointment, every candidate must be a European British subject of non-Asiatic domicile.
Candidates must have attained the age of 21 years and must not have attained the age of 24 years in the case of those applying for appointment to the Indian Service of Engineers, and 25 years in the case of those applying for appointment to the Indian Railway Service of Engineers, on 1st January, 1930.
The appointments are for Civil Engineers only. Candidates must either (1) have obtained one of certain recognised University Degrees or other Distinctions in Engineering; or (2) have passed Sections A and B of the Associate Membership Examination of the Institution of Civil Engineers or been exempted by the Institution from such examination; or (3) have passed the Associateship in Engineering of the City and Guilds Institute (Imperial College of Science and Technology, South Kensington); or (4) produced the required evidence that they are otherwise eligible under the Regulations. They should in addition have had about one year's approved practical experience in engineering.
Applications from candidates must reach the India Office not later than 31st October, 1930. Printed forms, together with information regarding the conditions of appointment, may be obtained from the SECRETARY, Services and General Department, India Office, Whitehall, S.W. 1. 5712

Ministry of Transport.
APPLICATIONS are INVITED from qualified Mechanical and Automobile Engineers for FULL-TIME NON-PENSIONABLE APPOINTMENTS of CERTIFYING OFFICERS in the various Area Traffic Commissioners' Offices in Great Britain at salaries of £600 to £700 per annum inclusive. Travelling, &c., expenses on the usual Civil Service Scale are payable in addition.
The duties of the appointments will be concerned with the Issue of Certificates of Fitness of Public Service Vehicles, and only applicants who have had technical training and practical experience as Mechanical and Automobile Engineers will be considered.
Forms of application can be obtained from the ESTABLISHMENT OFFICER, Ministry of Transport, Whitehall-gardens, S.W. 1. Last day for receipt of applications, 24th October, 1930. 5908

Royal Indian Marine.
APPOINTMENT OF ENGINEER OFFICERS.
The Secretary of State for India proposes to APPOINT THREE ENGINEER SUB-LIEUTENANTS in the Royal Indian Marine.
Candidates must be British subjects between the ages of 21 and 23 years, and must have completed five years' engineering training in a recognised Engineering Firm or Government Dockyard in the United Kingdom. Selected candidates may be required to undergo three months' training under the Admiralty before proceeding to India.
Further details and forms of application may be obtained from the SECRETARY, Military Department, India Office, London, S.W. 1. The form should be returned as soon as possible before the 10th November, 1930. All communications should be marked "R.I.M. Recruitment." 5892

Safety in Mines Research Board.
The Safety in Mines Research Board invite APPLICATIONS for ONE POST of JUNIOR ENGINEER.
The post is a whole-time one in connection with Research on Colliery Wire Ropes, and after about six months' work in Dublin will be tenable in London.
Candidates must possess good scientific qualifications, including a University Degree (or its equivalent) in Engineering, and must have taken a Course in Electrical Measurement.
Other things being equal, preference will be given to ex-Service men.
The post is graded as a Junior Assistant, with a scale of salary of £160 per annum, rising by annual increments of £10 to £190. In addition, a variable cost-of-living bonus is payable, making the present minimum of the scale £240.
Forms of application, which must be returned not later than 27th October, can be obtained from the UNDER-SECRETARY FOR MINES, Establishment Branch, Mines Department, Dean Stanley-street, London, S.W. 1. 5907

The High Commissioner for India REQUIRES an ASSISTANT ENGINEER INSPECTOR (Mechanical) for service in England. The post is non-pensionable with two years' probation.
Salary £150, rising by annual increments to £300, and on promotion to full Inspector to £400, with bonus on Home Civil Service Scale. At present the bonus on £150 is £77.
Candidates should be between 28 and 35 years of age and have good technical and shop training. All-round experience and A.M.I. Mech. E. or equivalent qualification preferred. Preference will be given to an Indian suitably qualified as regards training and experience.
Applications, stating age, training and experience, and enclosing copies of recent testimonials, to be sent to the DIRECTOR-GENERAL, India Store Department, Belvedere-road, Lambeth, S.E. 1, not later than the 24th October, 1930. 5894

SITUATIONS OPEN

WANTED, a COMMERCIAL ENGINEER, with Mechanical Engineering training, for a first-class European Firm in India representing several leading British manufacturers. Agreement for 5 years. Age about 30, unmarried. Salary to commence the equivalent of £600 a year, with annual increments and good prospects.—Apply in writing, with copies of testimonials, to Z.E. 637, care Deacon's, Fenchurch-avenue, E.C. 3. 5904 A

The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.
ARRANGED FOR CARD INDEXING.

The Loss of the Airship R 101. (P. 401)
THE ENGINEER, 10 - 10 - 30.

German Dragline Excavator Practice. (P. 388)
(M. BRUCKMANN.) THE ENGINEER, 10 - 10 - 30.

British and Asiatic Engineers. (P. 391)
(C. A. M. SMITH.) THE ENGINEER, 10 - 10 - 30.

Fusion Welding of Pressure Vessels. (P. 393)
THE ENGINEER, 10 - 10 - 30.

Marine Exhibition in Paris. (P. 396)
THE ENGINEER, 10 - 10 - 30.

Terminal Bushings for Extra-High Electric Pressures. (P. 407)
THE ENGINEER, 10 - 10 - 30.

Congress for Concrete at Liége. (P. 397)
THE ENGINEER, 10 - 10 - 30.

Permanence of Dimensions under Stress at Elevated Temperatures. (P. 408)
(W. H. HATFIELD.) THE ENGINEER, 10 - 10 - 30.

Electricity Supply and Flue Gases. (P. 394)
THE ENGINEER, 10 - 10 - 30.

The Vitkovice Steel Works. (P. 404)
THE ENGINEER, 10 - 10 - 30.

INDEX TO ADVERTISEMENTS, PAGE 97.

PUBLIC NOTICES

University of Durham.
ARMSTRONG COLLEGE, NEWCASTLE-UPON-TYNE.
LECTURESHIP IN CIVIL ENGINEERING.
The Council of Armstrong College invites APPLICATIONS for a LECTURESHIP in CIVIL ENGINEERING.
Salary, £300 to £350, according to qualifications.
Candidates must have had practical experience and have a good knowledge of Surveying. Duties to commence as soon as possible. Ten copies of applications and of not more than three testimonials should be lodged not later than Saturday, 1st November, 1930, with the undersigned, from whom further particulars may be obtained.
J. Y. T. GREIG, Registrar.
5916 Armstrong College.

The County of London Electric Supply Company, Limited.
BARKING POWER STATION EXTENSIONS, 1930.
TENDERS FOR THE SUPPLY OF CIRCULATING WATER PUMPS AND PUMP HOUSE EQUIPMENT.
The County of London Electric Supply Company, Limited, are prepared to receive TENDERS for the SUPPLY and ERECTION of CIRCULATING WATER PUMPS and PUMP HOUSE EQUIPMENT in connection with extensions to the Power Station at Barking.
Specifications may be obtained by circulating water pump and pump house equipment manufacturers from the offices of the Company by application on or after Tuesday, October 14th, 1930, and on payment of a fee of £5 5s. for the first copy and £2 2s. for every subsequent copy. Sums paid for any number of copies up to three will be refunded on receipt of a bona fide Tender.
Sealed Tenders, endorsed "Tenders for Circulating Water Pumps and Pump House Equipment," must be delivered and addressed to the CHAIRMAN and MANAGING DIRECTOR, The County of London Electric Supply Co., Ltd., County House, 46/47, New Broad-street, E.C. 2, not later than Noon on Tuesday, the 11th November, 1930.
The Company do not bind themselves to accept the lowest or any Tender. 5906

PUBLIC NOTICES

Bengal-Nagpur Railway Company, Limited.
The Directors are prepared to receive TENDERS for:—
23,850 YARDS CLOTH CANVAS FOR TARPAULINS.
Specification and form of Tender can be obtained at the Company's Offices, 132, Gresham House, Old Broad-street, London, E.C. 2, on or after Tuesday, 7th October, 1930.
A fee of 10s. will be charged for each copy of the specification, which is NOT returnable.
Tenders must be submitted not later than Noon on Tuesday, 21st October, 1930.
The Directors do not bind themselves to accept the lowest or any Tender, and reserve to themselves the right of reducing or dividing the order.
By Order of the Board,
R. GRANT, Secretary.
5890

Liverpool Corporation Waterworks.
THIRD INSTALMENT—VYRNWY SUPPLY.
HIRNANT-MORDA SECTION.
CONTRACT NO. 14.
The Water Committee of the Liverpool Corporation is prepared to receive TENDERS for the SUPPLY of about 5½ MILES of 42in. BITUMEN-LINED STEEL PIPES, together with a number of SPECIALS.
Specification and drawings may be inspected at the Water Engineer's Office, 55, Dale-street, Liverpool, on and after Monday, the 6th October, 1930. Copies of the specification and form of Tender may be obtained upon payment of a deposit of Five Guineas, which will be repayable upon receipt of a bona fide Tender and return of the documents and drawings issued.
Tenders, endorsed "Tender for Third Instalment Pipes," are to be sent through the post in a sealed envelope, addressed to "The Town Clerk, Municipal Buildings, Liverpool," so as to be delivered not later than 10 a.m. on Friday, the 17th October, 1930.
The Water Committee do not bind themselves to accept the lowest or any Tender.
WALTER MOON, Town Clerk.
Municipal Buildings, Liverpool, 30th September, 1930. 5870

PUBLIC NOTICES

Administrative County of London.
SOUTH CIRCULAR ROAD.
BRIDGE CARRYING SOUTHERN RAILWAY OVER WESTHORNE-AVENUE.
The London County Council invites TENDERS for the CONSTRUCTION of a NEW BRIDGE to carry the Southern Railway (Bexley Heath line) over Westhorne-avenue (South Circular Road), in the Metropolitan Borough of Woolwich. The contract will include the Supply and Erection of Temporary Trestles and Steel Girders with Rail Timbers required to carry the running lines during the construction of the permanent work; the Construction of the Abutments and the Supply, Erection and Painting of the Steel Superstructure, and the Concreting and Asphalting of the Deck of the New Bridge.
The form of Tender, specification, bill of quantities and drawings may be obtained, on and after 26th September, 1930, on application to the Chief Engineer, Old County Hall, Spring-gardens, S.W. 1, upon payment of £5 by cheque, draft or money order to the order of the London County Council. This amount will be returnable only if the tenderer shall have sent in a bona fide Tender and shall not have withdrawn the same. Full particulars of the work may be obtained on personal application, and the contract documents may be inspected before payment of the fee.
Remittances by post should be addressed to the Chief Engineer, Old County Hall, Spring-gardens, S.W. 1. Personal enquiries at Room 24, No. 3, Warwick House-street, Cockspur-street, S.W. 1.
The contractor will be bound to observe the provisions of a fair wages clause, the terms of which are set out fully in the instructions for Tender and form of contract and in "The London County Council Gazette."
No Tender received by the Clerk of the Council at the County Hall, Westminster Bridge-road, S.E. 1, after 4 p.m. on Monday, 20th October, 1930, will be considered.
The Council does not bind itself to accept the lowest or any Tender.
MONTAGU H. COX, Clerk of the London County Council.
5897

Administrative County of London.
The London County Council has a VACANCY for a HANDICRAFT MASTER with qualifications in Metal Work at the new Metal Work Room at the Bermondsey Central School (Bermondsey, W.). Candidates should be fully qualified handicraft masters.
Salary, Burnham Scale IV. for certificated teachers, with the possibility of becoming entitled ultimately to an allowance in respect of Central School work.
Apply, EDUCATION OFFICER (E.2), The County Hall, Westminster Bridge, S.E. 1 (stamped addressed foolscap envelope necessary), for form, to be returned by 20th October. Canvassing disqualifies.
MONTAGU H. COX, Clerk of the London County Council.
5905

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED by London Firm of Engineers' Merchants, a REPRESENTATIVE. First-class salary, expenses and commission paid, also car provided to suitable applicant who would invest not less than £500 in business, which would be secured.
Address P339, The Engineer Office. P339 A

WANTED, REPRESENTATIVE FOR SCOTLAND, —Manufacturers of Engineers' Small Tools, Jigs and Machine Shop Equipment REQUIRE REPRESENTATIVE resident in Glasgow. Liberal commission. State age and experience.—Address, 5913, The Engineer Office. 5913 A

AN OPENING will Shortly Occur where a CONSTRUCTIONAL STEEL WORK ENGINEER with experience as General Manager in this class of engineering would find an improving position. Applicants must be under 45 years of age, of good address, with exceptional references, experience and ability to deal with every side of the business.—Address in first instance and in confidence, giving fullest particulars and stating commencing salary required, 5881, The Engineer Office. 5881 A

ASSISTANT CIVIL ENGINEER REQUIRED on Contractors' Staff, large Reservoir Contract in North of England.
Salary, £250 p.a.
Must have had previous experience in Setting-out and Measuring-up of Work.
Apply in own handwriting, giving full particulars and copies of recent testimonials, 5915, The Engineer Office. 5915 A

CIVIL ENGINEER REQUIRED to Supervise Working of Drawing-office and generally assist in the Preparation and Carrying Out of Schemes of Water and Drainage.
Executive ability necessary.
Commencing salary £350, with prospects.
Apply by letter only, PARKER PEARSON and ROSS HOOPER, MM. Inst. C.E., Dallas Chambers, Chippenham, Wilts. P345 A

SITUATIONS OPEN (continued) Page 2.
SITUATIONS WANTED, Page 2.
AUCTIONS, Page 98.
MISCELLANEOUS, Page 2.
EDUCATIONAL, Page 2.
MACHINERY, &c., WANTED, Page 2.
PARTNERSHIPS, Page 2.
PATENTS, Page 2.
FOR SALE, Pages 2 and 98.
AGENCIES, Page 2.
WORK WANTED, Page 2.
FOR HIRE, Page 2.

For Advertisement Rates see Leader Page.

SITUATIONS OPEN (continued)

REINFORCED CONCRETE DESIGNER WANTED; must be proficient and have had experience with specialist firm.—Write, stating age, experience and salary required, to INDUSTRIAL CONSTRUCTIONS, Ltd., 54, Victoria-street, S.W. 1. 5884 A

REPRESENTATIVES for Sale of Rubber Transmission and Conveyor Belting.—Write, fullest details, experience, connection, &c., 5909, The Engineer Office. 5909 A

REQUIRED FOR WEST AFRICA.—MECHANICAL ENGINEER to Take Charge Running Plant. Must be experienced Maintenance and Repair, Steam and Electrical. Age 25/35. Salary £450/£500 p.a. Applicants to state age, qualifications and experience in detail.
Address, 5833, The Engineer Office. 5833 A

WANTED IMMEDIATELY, First-class DRAUGHTSMAN, experienced in design of High-class Petrol or Paraffin Engines for transport vehicles, marine or stationary purposes. State age, experience, and salary required.—Address, "DRAUGHTSMAN," Wm. Porteous and Co., Advertising Agents, Glasgow. P357 A

CRANE DRAUGHTSMAN REQUIRED for Large Crane Works in the North of England.
Wide experience in Steam Cranes essential.
Address, stating age, experience, and salary required, 5901, The Engineer Office. 5901 A

GOOD MECHANICAL DRAUGHTSMAN, with experience of Cranes and Hoists. Give full details and salary required.—Address, 5914, The Engineer Office. 5914 A

ASSISTANT FOREMAN PATTERNMAKER.—One of the largest GENERAL IRONFOUNDRIES REQUIRES the SERVICES of an ASSISTANT FOREMAN PATTERNMAKER, age 28-33 years, with experience in Green Sand, Dry Sand, and Loam Jobbing Work, and also in Up-to-date Machine Moulding. Able to fix piece rates and of good personality.—Address, giving full details, including salary required, 5902, The Engineer Office. 5902 A

SITUATIONS WANTED

A PRODUCTION ENGINEER (32), with Extensive exp., in plant development and production control, OFFERS SERVICES; sound, all-round man with extensive practical knowledge.—Address, P361, The Engineer Office. P361 B

CHEMICAL ENGINEER, Practical, Technical, with extensive administrative and executive experience, at present in control of several works, specialities cost reduction, labour control, DESIRES CHANGE. Salary not less than £2000 p.a.—Address, P353, The Engineer Office. P353 B

CIVIL ENGINEER (28), Cambs. Hons. Degree, 5 years' pract. exp. abroad, DESIRES POST, home or abroad; immediate engagement.—Address, P354, The Engineer Office. P354 B

COMPETENT ENGINEER (30). Well Educated, first-class training, extensive experience at home and abroad in all types steam plant, pumps and internal combustion. Has held administrative position; excellent with labour. Highest credentials. Disengaged.—Address, P344, The Engineer Office. P344 B

ENGINEER and PATTERNMAKER (Maintenance), D.O. experience, good worker, reliable, DESIRES EMPLOYMENT. Age 35. References.—Address, P351, The Engineer Office. P351 B

ENGINEER, B.Sc. (Hons.), (28), Well-educated, single, invest £500 if reqd., DESIRES PROGRESSIVE POST, home or abroad; 3 yrs. shops, 4 yrs. D.O., 3 yrs. industrial firm; exp. on steam engines, condensing plant, chem. plant, milling machinery, buildings, concrete, material handling, testing, estimating.—Address, 5910, The Engineer Office. 5910 B

ENGINEER DESIGNER, Rapid Detailer, Exp. in cars and comm. vehicles, steam, petrol, low loading, 2 to 8-wheel trailers, REQUIRES IMMEDIATE ENGAGEMENT in drg. office, shops or internal organisation. — Address, P355, The Engineer Office. P355 B

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ENGINEER MANAGER or REPRESENTATIVE OPEN for OFFER. Cranes, conveying, mech. handling, mining mov., design, production, sales, &c. Accustomed to work requiring responsibility, initiative and resource. Knowledge of Continent, Spanish and French.—BM/ZPPL. P340 B

ENGINEER (Young), Maintenance and General Production work. In charge of factory, plant layout, &c., SEEKS similar SITUATION. Ex. refs. London preferred.—TROTT, 4, Wanlip-road, Plaistow, E. 13. P347 B

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BM/L024, London, W.C. 1. P352 B

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Travelled widely, perfect French.
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All executive duties. Expert organiser. Welfare, safety, apprentice training schemes, and labour control. Valuable technical and practical experience with the modern ferrous and non-ferrous alloys, including heat treatment, machining, fabrication and welding, riveting, &c. Batch production of high-quality interchangeable machined parts in mild steel and austenitic steel alloys, and exceptional experience in general engineering practice in large works.
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Active, conscientious, adaptable and essentially practical. Excellent credentials.
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MECHANICAL ENGINEER, A.M.I. Mech. E., A.M.I.A.E. (32), SEEKS PROGRESSIVE POST, London district. Willing to invest as guarantee of business interest.—Address, P341, The Engineer Office. P341 B

M. ENG., A.M.I.E.E., Just Returned from 2 Years' Diesel-electric traction work in Spain, REQUIRES POSITION as ENGINEER or REPRESENTATIVE, Spain or England. Fluent Spanish. Good references.—Address, P349, The Engineer Office. P349 B

REPRESENTATIVE, with 25 Years' Connection, Midlands and South, belting (con. and trans.), mechanical goods, &c., known to most big buyers, would like to REPRESENT good FIRM, any line.—M., 187, Croydon-road, Anerley, S.E. 20. P363 B

MECH. DRAUGHTSMAN (29), 15 Yrs. Exp., hydraulics, pump work, pipe line, valves, &c. London, £4.
Address, P358, The Engineer Office. P358 B

SITUATIONS WANTED (continued)

FOREMAN ERECTOR, Expd. Bridges," Sheds, floating landing stages, oil tanks, dock gates and caissons, also expd. greenheart work and launching.—Address, P342, The Engineer Office. P342 B

PARTNERSHIPS

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PATENTS

KING'S PATENT AGENCY, Ltd. (B. T. KING, Regd. Patent Agent G.B., U.S., and Can.), Advice, handbook and consultations on Patents and Trade Marks FREE.—146a, Queen Victoria-street, London, E.C. 4. 43 years' ref. 'Phone: Central 0682. 4721 H

"IMPROVEMENTS IN AND RELATING TO FUELS FOR INTERNAL COMBUSTION ENGINES." THE OWNERS of BRITISH PATENT No. 245,972 are WILLING to ENTER into WORKING ARRANGEMENTS for EXPLOITATION of the same in Great Britain.
Particulars obtainable from TECHNICAL RECORDS, Limited, 59-60, Lincoln's Inn-fields, London, W.C. 2. 5891 H

THE PROPRIETOR of BRITISH PATENT Nos. 190,821, 190,822 and 187,816, all dated October 1, 1921, relating to "Improvements in Mattress Roll Forming Machine," "Improvements in Mattress Roll Forming Machines," and "Intermittent Movement Mechanism for Mattress Sewing Machines," respectively, is DESIROUS of ENTERING into ARRANGEMENTS by way of a LICENCE or otherwise on reasonable terms for the purpose of EXPLOITING the above patents and ensuring their practical working in Great Britain.—All inquiries to be addressed to B. SINGER, Steger Building, Chicago, Illinois. 5893 H

THE PROPRIETORS of BRITISH PATENT No. 278,745, for "Improvements in and relating to the Manufacture of Hydrocarbons and Substances Containing Adsorbed Hydrocarbons," are DESIROUS of ENTERING into NEGOTIATIONS with interested parties for the GRANTING of LICENCES thereunder on reasonable terms or for the SALE of the PATENT outright.—Communications please address to Messrs. DICKER, POLLAK and MERCER, Chartered Patent Agents, 20-23, Holborn, London, E.C. 1. 5895 H

THE PROPRIETOR of BRITISH PATENT Nos. 246,602, dated November 13th, 1924, relating to "Improvements in a Cup Blank Punching Machine"; 241,400, dated November 13th, 1924, relating to "Improvements in and Relating to the Counting Mechanism of Machines for Forming Paper Cups and Like Containers," and 248,075, dated November 27th, 1924, relating to "Improvements in a Paper Cup Forming Machine with Stacking Attachment," is DESIROUS of ENTERING into ARRANGEMENTS by way of a LICENCE or OTHERWISE on reasonable terms for the purpose of EXPLOITING the above PATENTS and ensuring their practical working in Great Britain.—All inquiries to be addressed to B. SINGER, Steger Building, Chicago, Illinois. 5857 H

THE PROPRIETOR of BRITISH PATENT No. 203,546, dated October 3rd, 1922, relating to "Cutter Head for Wood Working Machines," is DESIROUS of ENTERING into ARRANGEMENTS by way of a LICENCE or OTHERWISE on reasonable terms for the purpose of EXPLOITING the above PATENT and ensuring its practical working in Great Britain.—All inquiries to be addressed to B. SINGER, Steger Building, Chicago, Illinois. 5858 H

THE PROPRIETOR of BRITISH PATENT No. 216,429, dated October 1st, 1923, relating to "Devices for Separating Dust from Air," is DESIROUS of ENTERING into ARRANGEMENTS by way of a LICENCE or OTHERWISE on reasonable terms for the purpose of EXPLOITING the above PATENT and ensuring its practical working in Great Britain.—All inquiries to be addressed to B. SINGER, Steger Building, Chicago, Illinois. 5856 H

FOR HIRE

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MACHINERY, &c., WANTED

WANTED, ELECTRIC LOCO. TRAVELLING CRANE, to lift 5 tons at 25ft. radius. Steam would be considered.
Address, P359, The Engineer Office. P359 F

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The Last Voyage of the R 101.

The wireless messages sent out from the "R 101" enable us to compile a fairly complete log of her voyage. She unmoored from the tower at Cardington at 7.30 p.m. on Saturday, October 4th, and after making a circle over Bedford, set her course for London at 7.54. She reached London at 9 p.m. At 9.21 p.m. she was still over London and her course had been set for Paris. At 10.35 p.m. she crossed the coast near Hastings. At 10.47 p.m. she reported that it was raining hard and that there was a strong south-westerly wind. She was at that time recovering water ballast. At 12.36 a.m. she was crossing the French coast at Pointe de St. Quentin, and at 1 a.m. she reported her position as 15 miles south-west of Abbeville, and her height, according to the altimeter, as 1500ft. At 1.8 a.m. she informed the Croydon station that she would not require its services any more that night. The operator at that station decided, however, to remain on duty, and shortly before 2 a.m. he heard the airship asking the Le Bourget station to plot her position. The French station replied estimating her position by the direction finder as 1 kilom. north of Beauvais. The vessel crashed at Allonne, a few miles south of Beauvais. The watches of many of the victims were found to have stopped at 2.10 a.m. The times given are all British summer time. The direct distance from Cardington to Allonne measures about 225 miles. The vessel's average speed was, therefore, of the order of 36 miles an hour. A detailed examination of the speed for the different stages shows that it did not vary greatly. From Cardington to London it seems to have been about 37 m.p.h. From London to Hastings it was about 35 m.p.h. Crossing the Channel it fell to about 33 m.p.h., but after reaching the French coast, until the airship passed over Beauvais, it appears to have risen to some 41 m.p.h. These speeds are undoubtedly low, but not excessively low in view of the strong wind which was blowing.

Speculations on the Cause of the Disaster.

Until the Court of Inquiry, consisting of British and French representatives, has presented its report, attempts to assign a cause for the disaster must be largely speculative, for the facts so far disclosed concerning its circumstances are unofficial and incomplete. Many possible reasons have been suggested. We will not attempt to add to their number, but it seems desirable to call attention to evidence provided by the log summarised above, which goes some way towards negativing certain explanations that have been advanced. In the first place, it will be noted that at 10.47 p.m. it was raining hard and that the ship was recovering some of the rain which was falling on her hull for use as ballast. If less than three hours after the start she was taking in ballast, it seems difficult to believe, as has been suggested, that she was overloaded at the beginning of her trip. Secondly, at 1 a.m. the airship reported that she was flying near Abbeville at a height, according to the altimeter, of 1500ft. That altitude was quite normal. If, then, the vessel became overloaded by the accumulation of excess rain during the voyage, the excess could not have been acquired before 1 a.m. It is difficult to believe that it accumulated during the last hour, for at 1 a.m. the heavy rain previously reported had changed to an intermittent rain. Finally, the examination of the average speed on the different sections of the voyage suggests that it was actually higher on the last stage just before the disaster than on any of the earlier stages. This consideration negatives to some extent suggestions of engine trouble. The weather was bad and the barometer was low, but all the facts revealed in the log strongly imply that the voyage was normal in all other respects up to a few minutes before the catastrophe occurred. It may be noted that the wireless messages received from the airship contained several references to the cloud formations encountered. This information will, no doubt, prove of much moment in the discussion of the meteorological factors attending the disaster.

Dry-Docking the New Cunard Liner.

In a Journal note of September 26th we referred to the statement of the Cunard Steamship Company, Ltd., that the question of dry-docking the proposed new liner at Southampton was still being amicably discussed with officials of the Southern Railway Company. In the course of a statement he made on Saturday last, October 4th, Mr. Gilbert S. Szlumper, the assistant general manager of the Southern Railway Company, made known the fact that, in addition to the proposals for building a large graving dock or constructing a new floating dry dock, the question of utilising the present 60,000-ton dock is not escaping the attention of the company's dock engineers. It appears that the existing dock could be made to comply with the requirements of a 70,000-ton ship were new sections to be added and certain of the existing sections strengthened or replaced. Whether it be eventually decided to alter the existing dock, to build an entirely new dock, or to embody a large graving dock in the Southampton harbour scheme, it is very desirable that further probable increases in tonnage which may take place in the next ten or twenty years should be carefully taken into account. If this is not done the problem will almost certainly need to be faced again after a few years. One advantage of constructing a large new floating dry dock would be that the sections immediately required for the new Cunarder could so be designed that at a later date others might be added to increase the capacity of the dock to deal with tonnages almost double those of the largest ships of to-day.

The New Ford Works at Dagenham.

At the beginning of the week, Mr. Henry Ford, who at present is on a visit to this country, made an interesting statement with regard to the progress which is being made with the new Ford works at Dagenham and its output. The construction of the works, Mr. Ford stated, was proceeding satisfactorily, according to plan, and in about another twelve months the beginning of production might be expected. The designed capacity of the works is 1000 vehicles per day of eight hours, which output will be supplemented by 200 tractors per day produced at the Cork works in Ireland. About three-quarters of the output of the Dagenham factory is intended for export abroad. The Ford company, Mr. Ford went on to say, had had considerable difficulty in finding British manufacturers for the various commodities which were required to replace similar supplies in the United States. He was of the opinion that there were many good openings for British firms which could manufacture these steel and other commodities, which were now generally purchased in foreign markets by both British and European motor car manufacturers. One of the principal features of interest at the new Dagenham works is the power plant. The boiler equipment comprises three high-pressure Babcock and Wilcox boilers, each designed for a rated steam output of 205,000 lb. per hour, with a safety valve loading of 1400 lb. per square inch and a final superheated steam temperature of 750 deg. Fah. There are also two smaller boilers of the same type, each having an evaporation of 35,000 lb. of water per hour, with a safety valve loading of 217 lb. per square inch. The boilers are so designed that either pulverised coal or gases from a refuse destructor can be utilised, while arrangements are also provided whereby, if desired, blast-furnace gas can be used in conjunction with refuse.

The Parsons Marine Steam Turbine.

In the report of the Parsons Marine Steam Turbine Company, Ltd., for the year ended June 30th, 1930, it is stated that the works have been occupied during the year on the completion of the propelling machinery for H.M. cruiser "Exeter," and on the high-pressure geared turbines for H.M. destroyer "Acheron," which machinery is now being installed in the respective ships. During the year some single-screw geared turbine machinery has also been completed and gearing has been cut to the orders of the company's licencees. With regard to the application of low-pressure turbines to existing reciprocating engines, using the Parsons patented spring type flexible coupling, the company has now received an order from the Joseph Constantine Steamship Line, Ltd., of Middlesbrough, for the installation of a low-pressure turbine with gearing, for use in combination with the reciprocating engines in one of the company's existing steamers. The various licencees of the company in this country and in America and on the Continent are constructing turbines of the Parsons type for all classes of naval and mercantile ships. The fuel economies which have been obtained and are being maintained in ships fitted with high-pressure and high-temperature Parsons turbines have, it is remarked, borne out fully the claims for improved efficiency made by the company, and the success achieved is reflected in the extended use of high-pressure steam plant in large liners now under construction, both in Great Britain and abroad. The directors regret the death of their co-director, Mr. A. A. Campbell Swinton, and have elected, subject to the confirmation of the shareholders, Mr. Stanley S. Cook, the technical manager, and Mr. W. H. Pilmour, the secretary of the company, as new directors.

An Electrically Propelled Motor Tanker.

On Saturday last, October 4th, a new electrically-propelled motor tanker for the Atlantic Refining Company, of Philadelphia, was safely launched from the Cartsdyke shipyard of Scott's Shipbuilding and Engineering Company, Ltd., of Greenock. She was named the "Winkler" by Mrs. James Brown. The new tanker has a length of 420ft., with a beam of 58ft. and a depth of 35ft., and she is designed to carry 10,000 tons of lubricating oil on a light draught, with a measurement of about 7000 gross tons. The propelling machinery is arranged aft, and it comprises four sets of six-cylinder, four-stroke, single-acting, Carels-Ingersoll-Rand oil engines, which are directly coupled to the main and auxiliary generator sets. Each of the main generating sets has an output of 650 kW at 250 volts when running at 225 r.p.m., and the four generators, working in series, supply current to the propelling motor, which is of the double-armature pattern. It is directly controlled from the pilot house on the bridge, and it has a designed output of 2800 S.H.P. at 95 r.p.m. The navigating instruments include a Sperry gyro-compass, with automatic steering equipment. All the deck and pumping auxiliary machinery is electrically operated. The complete electrical equipment has been supplied by the British Thomson-Houston Company, Ltd., of Rugby, and the engines have been built at Carels Works in Ghent. In appearance the "Winkler" is generally similar, although slightly smaller, than her sister ship, the "Brunswick," which we described a little over two years ago. The machinery installation has been carried out in accordance with the designs of Mr. Lester M. Goldsmith, of Philadelphia, the owners' consulting engineer. It is of interest to note that practically all the ships in the fleet of the Atlantic Refining Company are electrically propelled motor vessels. The results have been most satisfactory, both as regards fuel consumption and the reliability of the plants.

London Passenger Transport.

The Minister of Transport has recently been holding successive conferences with representatives of the various bodies concerned with the provision of passenger transport services in and around London. The bodies represented were the London County Council and other local authorities operating tramways, the Underground and Metropolitan Railway Companies, the Association of London Omnibus Proprietors, and other omnibus organisations, and the four amalgamated railway companies. Mr. Morrison laid before the representatives the scheme for the co-ordination of London transport, with which the Government proposes to proceed at once. Briefly, the scheme contemplates the establishment of a new statutory public body on the lines of the Port of London Authority, the Metropolitan Water Board, or the Central Electricity Board. This body would embrace the undertakings of the Underground group of companies, the Metropolitan Railways, and all the tramway and omnibus undertakings within the London area. It would be charged with the future management, operation, and maintenance of these undertakings as one consolidated transport system, and with the duty of making provision for further facilities as and when required. In view of the fact that the suburban lines of the amalgamated railway companies are inextricably bound up with the main lines, great difficulty would be experienced in bringing these suburban lines into any scheme of unified ownership. While it is not proposed to disturb the ownerships of these lines, it is intended that arrangements should be made which will have proper regard to the public interest, and at the same time enable the suburban lines to discharge their proper function in a fully correlated scheme of transport. Sir William McLintock has for some months past been engaged upon an investigation with a view to forming a plan for the consolidation of the financial interests concerned in the proposed scheme on fair and equitable terms. The capital represented in the undertakings which it is suggested should be brought under public ownership is estimated at between £115,000,000 and £125,000,000.

The New Dunston Power Station.

In a Journal note of September 5th we gave particulars of the three 50,000-kilowatt turbo-alternators which are to be supplied by C. A. Parsons and Co., Ltd., of Heaton, Newcastle-upon-Tyne, for the new Dunston power station of the Newcastle-upon-Tyne Electric Supply Company, Ltd. The company has now placed further orders amounting to over half a million pounds for the boilers, condensing plant and other auxiliary equipment. Of the twelve boilers which will be required, six are to be built by Clarke, Chapman and Co., Ltd., of Gateshead, and the remainder supplied by Babcock and Wilcox, Ltd., of London and Renfrew. It may be recalled that the turbines are to be designed to operate at an initial pressure of 600 lb. per square inch, with a final superheated steam temperature of 800 deg. Fah., and that reheating to 800 deg. Fah. is to be adopted. The boilers will be designed to supply steam at a working pressure of 625 lb. per square inch and at a final superheated steam temperature of 825 deg. Fah. Four of the twelve boilers are to be designed for burning pulverised coal on the Clarke-Chapman system, and the remaining eight will be equipped with the latest pattern of Babcock Wilcox stoker. An effort has been made to retain as much work as possible in the Tyne area, and for this reason Babcock and Wilcox, Ltd., have arranged to sub-contract a part of their order to Clarke, Chapman and Co., Ltd., thereby ensuring more employment at that firm's Gateshead works. The order for the condensers and auxiliary plant has been placed with Richardsons, Westgarth and Co., Ltd., of West Hartlepool, and this order extends to some £90,000. The work will be spread over a considerable period, during which time the required extensions at the Dunston power station will be carried out.

Recent Drag-Line Excavator Practice in Germany.

By Dipl.-Ing. BRUCKMANN, Leipzig.

A good deal of information has been published of recent years concerning the use of drag-line excavators for working the German lignite deposits, so that a general knowledge of these machines and of their functions may be taken for granted. The experience now gained in a good number of installations begins to indicate a general trend of development, and consequently it appears opportune to discuss some of the essential features of such plants and to examine the direction in which evolution is tending.

The task of the drag-line excavator is, as is well known, to remove the cover from the lignite beds and to deposit it in the place whence the lignite has been mined. The bridge conveyors—bridge-like structures provided with belt conveyors—effect the clearance in a similar way. The essential difference between the two kinds of apparatus is that the drag-line excavators dig out the earth themselves and deliver it by means of a cable system instead of by a fixed structure. On account of the back and forward travel of the dredging bucket, these excavators are obviously capable of the great outputs obtained with bridge conveyors. They meet, however, the requirements of workings, the size and conditions of which do not warrant the employment of apparatus of a large and costly nature. Furthermore, they have the advantage of being able both to cut out the coal and to deliver it on to the top of the dump bank. It is on account of this feature particularly that drag-line excavators are of such great interest to the brown coal industry, for the raising of the coal presents one of the most difficult problems of open-work mining. Formerly chain hoists were employed for this purpose, but the coal is now more usually hauled out of the pit by large railway wagons. The coal trains are, naturally, unable to climb directly out of an excavation which may be from 30 m. to 60 m. deep, but are compelled to make a long detour, often having to wind their way several times round the whole workings. The same sort of conditions are met with in other kinds of open-work mining, besides that of getting out lignite, and whenever they occur the advantages of the drag-line excavator deserve full consideration.

The general construction of the earlier type of drag-line excavator is illustrated in Fig. 1. The bucket is hung from a cradle which runs on the two main cables and is drawn to and fro by an operating rope. The main supporting cables can be raised and lowered at will, thus enabling the bucket to be brought into engagement with the ground. It is then drawn along by the excavating cable, which is continuous with the travelling cable, and so cuts itself into its work. When it is hoisted from the ground and its direction of travel reversed, it travels back to the dumping bank and there discharges its contents. All motions, in the case of such a machine, were performed by a single windlass housed in the tower of the machine on the burden side of the workings. This tower contained the operating room, whence the action of the machine could be supervised and controlled. Both towers were movable, so that the whole apparatus could be travelled along the workings in the manner customary in open-cut mining.

The development of drag-line excavators will be considered under six headings, namely, (1) the capacity of the bucket; (2) the design of the windlass gear; (3) the speed of working; (4) the discharging of the buckets; (5) the raising and lowering of the supporting cables; and (6) the design of the gear for travelling the towers.

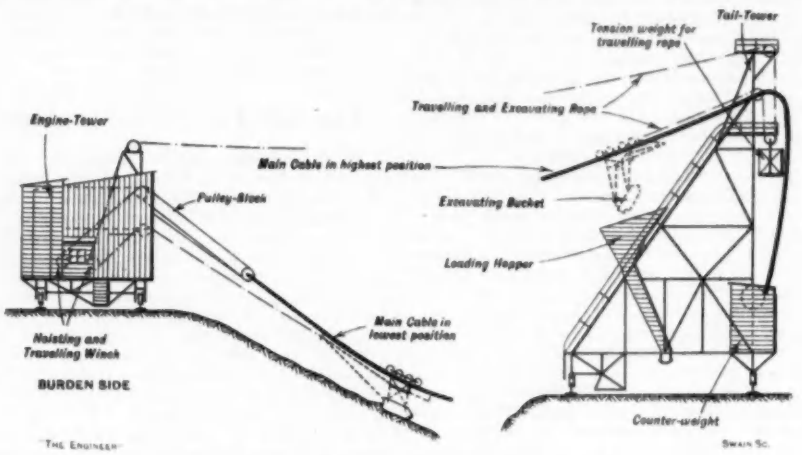


FIG. 1—A DRAG-LINE EXCAVATOR INSTALLATION

The Capacity of the Bucket.

In the first installation at the Stadt Görlitz Mine, near Kohlfurth, which was of the nature of an experimental plant, a beginning was made with a bucket of 2 cubic metres capacity. The next plant had a bucket of 4 cubic metres; then a capacity of over 6 cubic metres was adopted, while the latest installation works with a bucket of 8 cubic metres for removing the overburden and of 10 cubic metres capacity for coal getting.

The Design of the Windlass.

In the first excavators the whole of the necessary motions of the bucket were obtained from a common windlass. In this were combined the drum for the excavating and travelling motions and the drum for raising and lowering the bucket. The arrangement is illustrated in Fig. 2. Either of these drums could be put into motion at will by means of hand-operated clutches. Reversal was brought about by similar clutches, while the change over from the high travelling speed to the low excavating speed was also dependent on the operator. Only one motor was provided for the windlass. A similar arrangement was used for the bridge type of drag-line excavator employed at the Roddergrube Mine.

As a consequence of the design of the windlass, although it was possible to raise the bucket and run it back simultaneously to the dumping side, it was not possible to lower it whilst moving it in the reverse direction. To avoid the reduction of output caused by this limitation it was decided, in the third plant of the Gewerkschaft Friedrich, near Hungen, in Hesse, to divide the windlass into two separate parts, one for travelling and excavating, and the other for hoisting and lowering. Each part was driven by its own electric motor. The arrangement is shown in Figs. 3 and 4. Another change was the duplication of the

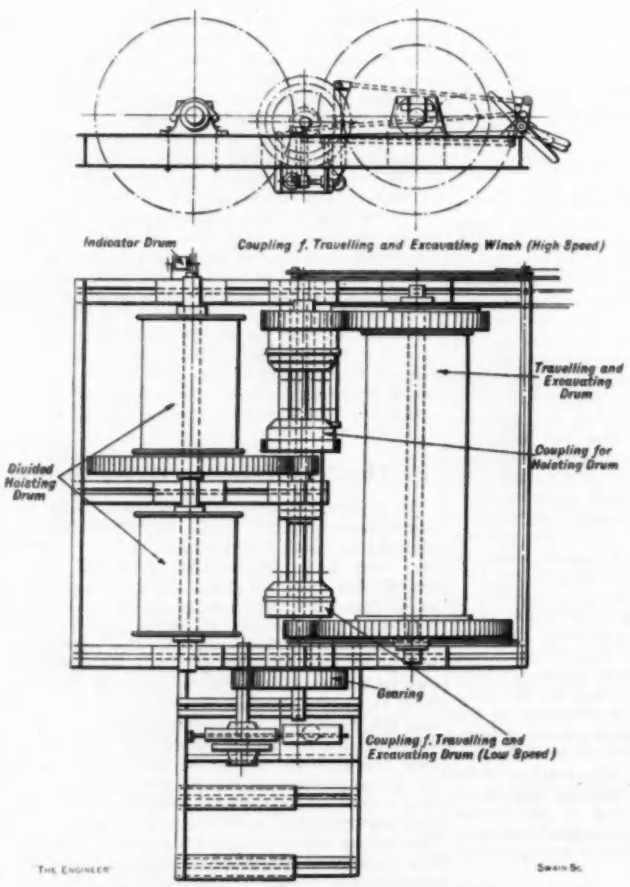


FIG. 2—EARLY DRAG-LINE EXCAVATOR WINDLASS

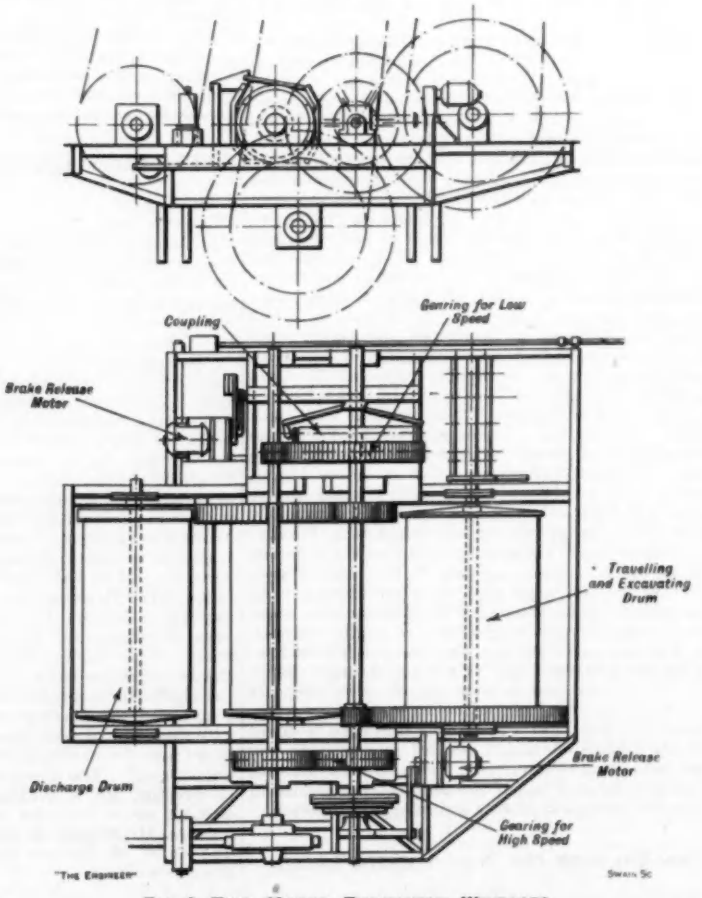


FIG. 3—TWO-MOTOR EXCAVATOR WINDLASS

operating cables in order that their diameter might be reduced. It was feared that single cables of the size required to deal with the heavy duties demanded in excavating would not have sufficient flexibility to prove durable under the constant bending round drums and pulleys. The design in question was adopted for the Görlitz II. installation, as well as for the Gewerkschaft Friedrich und Woelfersheim. The travelling and excavating winches of these excavators have a drum for discharging the buckets, in addition to duplicate travelling and excavating drums. The discharging drum runs loose and is fitted with a brake. The object of this drum will be further referred

to in connection with the subject of discharging. The brakes of the plants mentioned were electrically operated and the couplings worked by hand.

In the next four installations the travelling drum

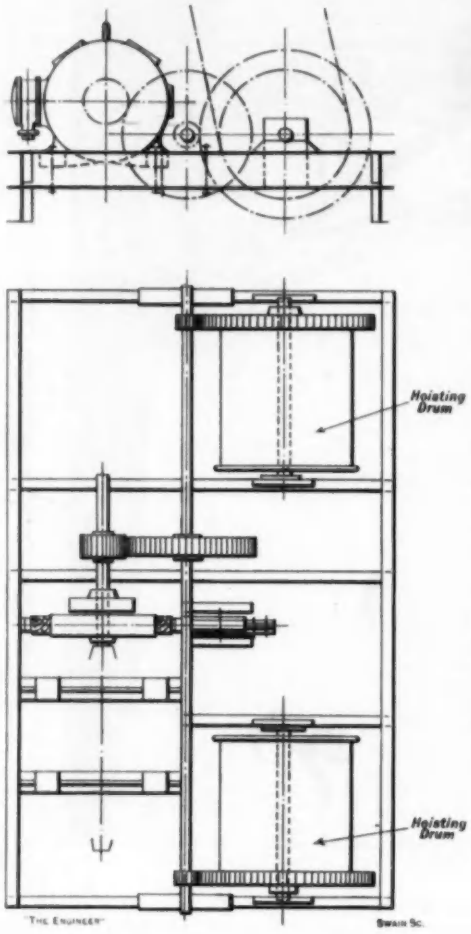


FIG. 4—TWO-MOTOR WINDLASS

was replaced by a differential gear and quill drive, the travelling cable being carried round several pulleys instead of a drum, an arrangement which has been found the best for aerial ropeways. It is shown

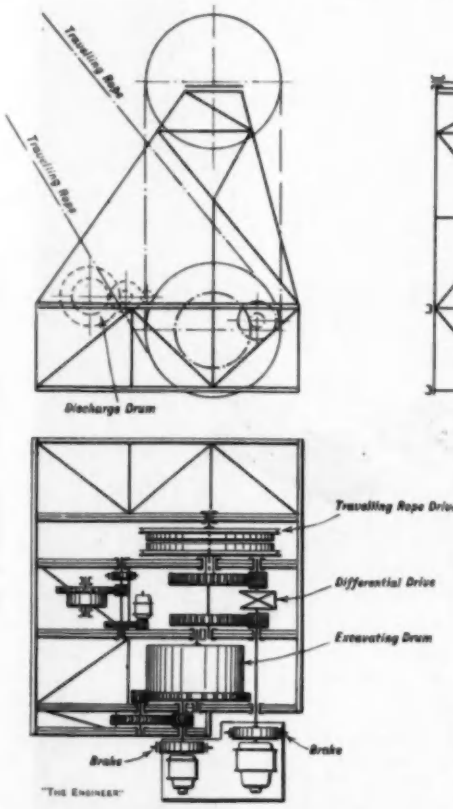


FIG. 5—DIFFERENTIAL-DRIVE WINDLASS

diagrammatically in Fig. 5. This design resulted in a noticeable simplification of the winding gear, as well as in a saving of weight. Drums were retained for operating the excavating cable. The drum for discharging the bucket was driven separately, for reasons which will be obvious when the nature of the operation is considered. The hoisting arrangements were not substantially different from those adopted in previous cases. All the drums were controlled by electrically-operated brakes and clutches. Many of the details were of interest, particularly the methods of automatically stopping the hoisting and travelling motions at the ends of their courses, but space does not permit of a discussion of them. The last word on the design of windlasses has not yet been said. There are still many problems to be solved, but they will present no insurmountable difficulties if approached in the light of the experience so far gained.

THE SPEED OF WORKING.

The earlier machines were designed for an excavating speed of 60 m. per minute, and that speed is still adhered to; nor does there appear any desire or necessity to depart from it. As to discharging, in so far as it concerns the moving of the bucket, the same speed has been chosen on grounds of convenience, and it has proved quite satisfactory. Hoisting and lowering speeds have undergone noticeable increases by reason of changes of design; the hoisting speed having been raised from 7·5 m. to 60 m. per minute. These speeds have reference to the vertical motion of the bucket. Although for the usual bucket lifts of 8 m. to a maximum of 60 m. an increase of hoisting speed is of no great significance, it constitutes, nevertheless, one step towards increasing the capacity of the plant.

Of obviously greater importance, so far as increased capacity is concerned, is the raising of the return speed of the bucket from 240 m. to as much as 480 m. per minute, which was made possible by the arrangement indicated in Fig. 2. The advantage of separating the drives of the hoisting and travelling drums has already been referred to, and it is in connection with the high working speeds just mentioned, that the change of design proves its full value. The success which has been attained will be evident from the consideration of the detailed times of the earlier working cycles, such as, for example, those of the Görlitz I. plant, which are given in the following table:—

	Seconds.
Excavating, about 10 m.	10
Hoisting, about 3 m.	5
Travelling, about 200 m.	50
Emptying	20
Lowering, about 3 m.	5
Travelling, about 200 m.	50
Contingencies	40
Total	180

It will therefore be seen that twenty such cycles can be carried out per hour.

In later designs the time, inclusive of excavating and emptying, has been reduced to 115 or 110 seconds for the same length of journey. This has been brought about mainly by the shortening of the travelling period to 35 seconds, in which hoisting or lowering is included, so that a saving of 40 seconds per round trip is made on this account alone. Such speeds can be counted on in modern machines, which make from twenty-five to thirty complete trips per hour, in spite of their somewhat longer average working distances and their larger buckets. Assuming eighteen or twenty hours as the longest practicable working day, a bucket of 6 cubic metres, making twenty-five round trips per hour, will handle 3000 cubic metres per day. It has been found in practice that the output is very little diminished during the hours of darkness and in bad weather, especially if the machine is working under favourable circumstances and no great exactitude is demanded in controlling the onset of the bucket.

THE DISCHARGING OF THE MATERIAL.

In the times given above for a round trip a material shortening of the period necessary to empty a bucket of given size would have an important effect. But the quick, clean and thorough discharge of a bucket presents no little difficulty. The bucket hangs in an inclined position on its journey, as shown in Fig. 7, page 390, with its cutting edge upwards, so that none of its contents shall be spilt on the way. To empty it, it has to be turned through an angle of 90 deg. This was effected, in the case of the Görlitz I. plant, by the cradle running against two stops attached to the supporting cables. The cradle carried on the end nearest the dump bank a projection with two movable guide rollers. These were arrested by the stops, whilst the continued motion of the cradle carried the projecting piece under the stops. As a consequence, it caused a pull on the chains attached to the back end of the bucket, thereby causing the latter to be tipped up, as shown in Fig. 8. In such a case the dumping took place far from the driver's position and the estimation of the distance was very difficult, so that the driver had to lower the speed fairly early in order not to exceed 60 m. per minute at emptying, otherwise the heavy blow might displace the cable even if it did not cause further damage. Sometimes, therefore, the round trip took considerably longer than it should have done. Furthermore, the fixed stops on the supporting cables made the altering of the dumping place a matter of unnecessary difficulty. Consequently, in the Roddergrube installation, although the same principle of discharging was adhered to, the stops were arranged so as to be movable along the cable by means of a special winch. In the next plants, namely, Görlitz II. and Friedrich, a discharging cable was adopted for the first time, this cable being attached to the discharging drum on the travelling windlass and running loose during the travel of the bucket. When the latter reaches the dumping point the discharging drum is braked, thereby tightening the cable and so causing the bucket to tip. By this method it is possible to choose the dumping place at will and to alter it at any moment. Dumping is effected without

FIG. 6—EXCAVATOR TOWER WITH OVERHEAD PENDULUM HOISTING GEAR

shock, all the motions take place easily, and the whole operation is much more smoothly performed.

So long as excavation was confined to light sandy soils, as was at first the case, the complete emptying of the bucket presented no special difficulty and the existing design gave perfect satisfaction. But as soon as an attempt was made to deal with soil of a clayey nature, which was, moreover, hard to pierce, the stickiness of the material caused trouble and the bucket would only dump its load slowly and incompletely. The dirt remained chiefly at the back end of the bucket, where it was consolidated by the pressure of excavating and the weight of the charge resting on it. This circumstance indicated an appropriate solution to the problem. The slope of the bucket during its journey was made considerably steeper, so that the upturning of the bucket at the end of its excavating stroke would give a natural angle of repose to the hitherto almost vertical material between the end of the excavation and the top of the overburden. Thus the dirtying of the uncovered coal surface by soil falling from the bucket during its travel was avoided. Also the bucket was provided with a dirt valve which would open and shut, as shown in Fig. 9. The valve had to remain shut during the work of excavating, while opening easily and completely when the bucket arrived at the dumping place. These requirements were perfectly fulfilled by the design adopted, which furthermore enabled a cleaning knife to be operated by the opening motion so as to loosen the sticky material.

The bucket is hung from its cradle by two cables attached to its front and back ends respectively. The dumping rope, which can be slacked and tightened up, is fastened on the fulcrum point of the bucket and its floor. The slacking of the rope allows the bucket to open by its own weight, while tightening the rope closes the bucket. A greater closing power can be obtained by attaching the cable to the end of a lever instead of directly to the fulcrum point. In order that the bucket shall not open whilst cutting, a safety

EXAMPLES OF GERMAN DRAG-LINE EXCAVATORS IN OPERATION

ADOLF BLEICHERT & CO., LEIPZIG, ENGINEERS

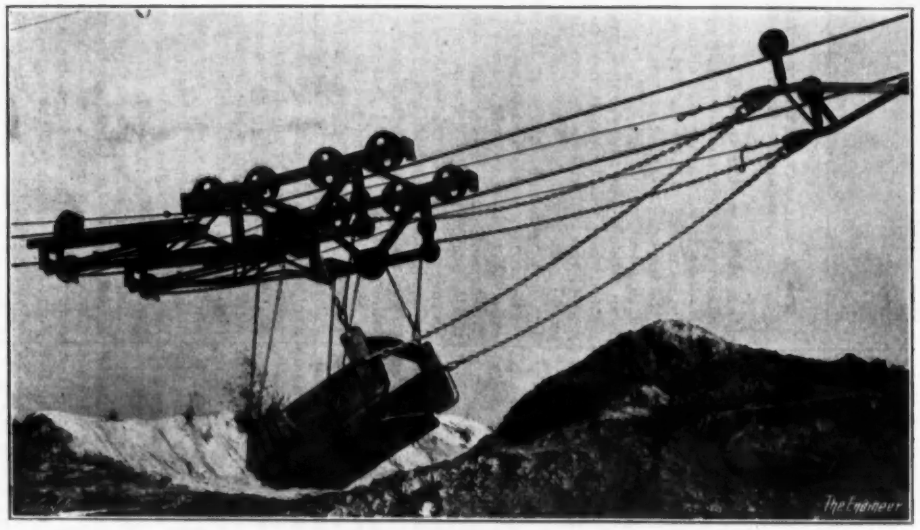


FIG. 7—POSITION OF LOADED BUCKET WHEN TRAVELLING

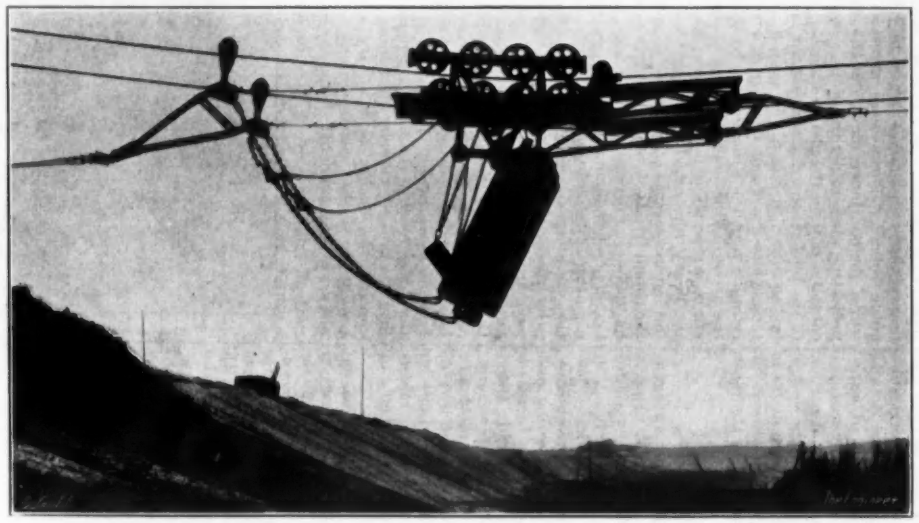


FIG. 8—APPEARANCE OF BUCKET AFTER TIPPING

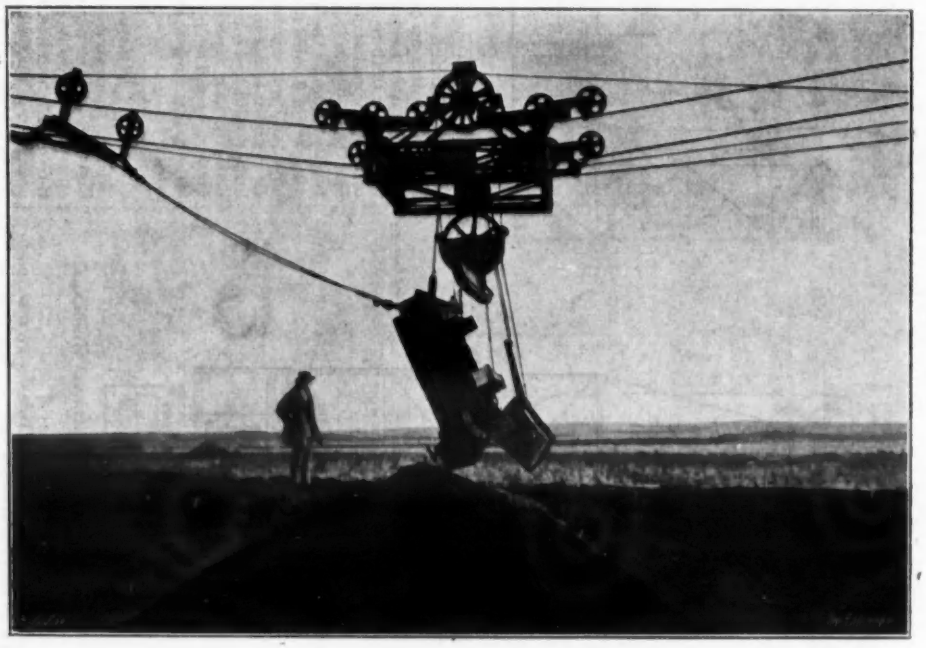


FIG. 9—BUCKET WITH MOVABLE DOOR

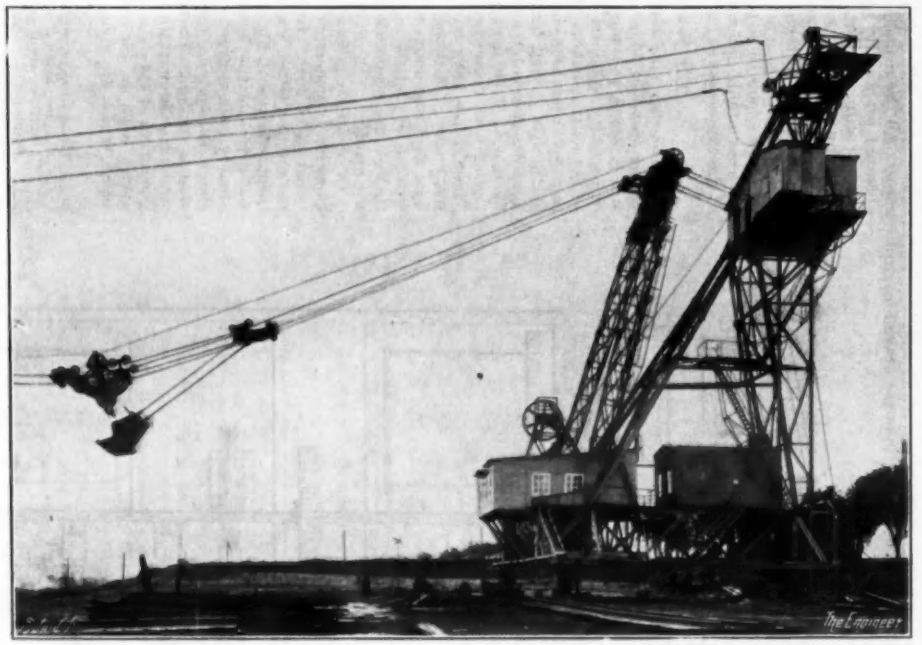


FIG. 10—CABLE TOWER WITH BOTTOM PENDULUM HOISTING GEAR

catch is provided, which closes on the descent of the bucket and is freed during the hoisting.

The bucket is arranged to empty itself in its travelling position, the contents leaving it at the same angle as that at which they entered. The forces on the sides and floor of the bucket are thus minimised and experience shows that the best results are obtained with this kind of discharging. It was fitted as an addition to the Roddergrube plant, but with a special arrangement of the opening device, because the windlass was not provided with a discharging barrel. In this case the opening and shutting of the bucket was brought about by the cradle running up to a button in a cable, an arrangement already in use on cable cranes.

The Hoisting and Lowering of the Supporting Cables.

In the first designs the hoisting and lowering of the supporting cables was effected by a pair of eight-rope pulley blocks acting on a cross piece which carried the cables. The end of the tackle was led round the hoisting drum. It is obvious that by such an arrangement the hoisting could only be done slowly. Consequently the principle was abandoned immediately and the ends of the supporting cables were attached to the end of a pendulum hinged to the tower and capable of swinging in the plane of the work. The pendulum, in the Gewerkschaft Friedrich, was pivoted at the top of the tower as shown in Fig. 6. This arrangement gives a simple run for the hoisting cable and permits of a clear open design, but it requires a high cable tower and, of course, depends somewhat on the conditions of the mine. On this account, in the more recent installations of Borken, Frielendorf and Viktoria III., the fulcrum of the pendulum is beneath, which not only permits of a less height of tower, but also an increase of the hoisting speed. The arrangement is illustrated in Fig. 10. The weight of the pendulum is balanced by a counterpoise which acts as a brake when the cables are being lowered and assists the motor when they are being raised. The use of a pendulum hinged at the bottom is likely to become general in the future.

The Design of the Tower Travelling Gear.

The plants at Görlitz I., Görlitz II., Woelfersheim and Borken were made to move on rails laid along the edge of the workings. It was thus possible for their designers to avail themselves of the experience already gained with aerial transporters and travelling cranes. In the case of drag-line excavators the efficient support of the towers and particularly of the machinery tower on the sides nearest to the workings is of special importance. This support is usually given by means of an inclined strut resting on a rail.

The excavator at the Gewerkschaft Friedrich has its tail tower movable on rails, but the machinery tower travels on caterpillar tracks. The original intention was to mount the whole apparatus on caterpillar tracks, but it was subsequently decided to make the experiment first on the machinery tower alone. Experience has shown that it is perfectly possible to build practical and reliable caterpillar tracks for drag-line excavators. Both towers of the Roddergrube, Frielendorf and Viktoria plants are mounted on such tracks, the appearance of which is shown in Fig. 11. It cannot be said, however, that the design of caterpillar tracks is yet finally settled. It is indeed probable that the variation of soil conditions will prevent any single form of construction from being applicable to all cases. Furthermore, experience shows that the ordinary designs of caterpillar, even if built for very similar duties, are not very suitable for the purposes of cable excavators. The reason for this lies probably in the fact that caterpillars for cable excavators are specially called on to resist the strong and varying side pull of the cables tending to drag the towers towards the workings. Trouble from this cause has been extraordinarily slight, although in the case of similar apparatus serious difficulties have been encountered.

The mounting of the towers on caterpillars, and especially the equalisation of the load on the different caterpillars, and the maintenance of the alignment of the individual caterpillars of a tower, are all questions to which the constructors have found completely satisfactory answers. There is thus no room for doubt that the caterpillar design lends itself to perfect safety, so far as present experience goes, while the difficulties peculiar to it have all been overcome.

The development of this interesting piece of apparatus is thus a good demonstration that a technically correct conception can triumph over the greatest obstacles in the way of its realisation. There is no secret that serious difficulties have been encountered in various installations, but every competent engineer knows well that there is a great future before the drag-line excavator in the brown coal industry. A list of the present plants, with their leading particulars, is given in the accompanying table, and completes the picture of this branch of engineering. It should be mentioned that the Roddergrube installation is built as a bridge cable conveyor. The bridge construction serves simply to take the tension of the supporting cables, which, as in the ordinary drag-line excavators, serve as a runway for the bucket. The layout of the Roddergrube Mine is such that it was impossible to support the cables by towers on the two sides of the workings. The bridge construction in this case has nothing in common with that used for bridge conveyors or similar apparatus.

Table.—*Particulars of Drag-line Excavators Employed in the German Lignite Workings.*

	Görlitz I.	Görlitz II.	Gew. Friedrich.	Roddergrube.	Wölfersheim.	Preussenelektra-Borken.	Bubiag-Frielendorf.	Viktoria III.
Nature of travelling arrangements	Rails	Rails	Rails for tail-tower: caterpillar for machinery tower	Bridge cable excavator on caterpillars	Rails	Rails	Caterpillars	Caterpillars
Material handled and weight in kg. per m.³	Overburden 1800	Overburden 1800	Overburden 1800 Coal 750	Overburden 1800	Overburden 1800	Coal 700	Overburden 1800 Coal 750	Overburden 1800 Coal 700
Type of bucket	Tip bucket	Tip bucket	Tip bucket	Opening bucket	Opening bucket	Opening bucket	Opening bucket	Opening bucket
Capacity of bucket, m.³	2	4	4	8	4	6	10 for coal 8 for overburden	8 or 10
Number of trips per hour	20	30	30	32 to 35	30	25	28	30
Cubic metres excavated per hour	40	120	128	187	120	150	186	265 dirt 345 coal
Maximum span in metres	320	300	350	150+100	300	325	420	350
Working speeds, metres per minute—								
Travelling	240	480	480	480	480	480	480	480
Excavating	60	60	60	60	60	60	60	60
Hoisting and lowering	7·5	24	24	8	14	60	60	60
H.P. required—							Overburden Coal	
Travelling	130	225	225	150	230	150	270 200	200–550
Excavating	130	225	225	150	230	150	200 to 500 290	200–500
Hoisting and lowering	100	140	140	150	150	200	320 320	200–500
Tower moving	16	15	90* 36†	40	50	55	110	90
Sizes of cables—								
Supporting cables	2×38 mm. dia.	2×40 mm. dia.	2×40 mm. dia.	2×44 mm. dia.	2×40 mm. dia.	2×36 mm. dia.	2×45 mm. dia.	2×46 mm. dia.
Excavating cables	1×24 mm. dia.	2×22 mm. dia.	2×24 mm. dia.	2×24 mm. dia.	2×25 mm. dia.	2×25 mm. dia.	2×30 mm. dia.	2×30 mm. dia.
Travelling cables	1×21 mm. dia.	2×22 mm. dia.	2×24 mm. dia.	1×24 mm. dia.	2×24 mm. dia.	2×25 mm. dia.	2×22 mm. dia.	2×22 mm. dia.
Hoisting cables	1×21 mm. dia.	2×22 mm. dia.	2×22 mm. dia.	1×24 mm. dia.	2×24 mm. dia.	4×34 mm. dia.	4×42 mm. dia.	4×42 mm. dia.
Balancing cables	—	2×24 mm. dia.	2×22 mm. dia.	1×24 mm. dia.	—	2×34 mm. dia.	2×42 mm. dia.	2×42 mm. dia.
Tipping cables	—	1×19 mm. dia.	1×21 mm. dia.	—	1×22 mm. dia.	—	—	—
Emptying cables	—	2×19 mm. dia.	1×21 mm. dia.	—	1×22 mm. dia.	1×19 mm. dia.	1×24 mm. dia.	1×24 mm. dia.

* Machinery tower. † Tail tower.

Fig. 11—Cable Tower on Caterpillar Tracks

British and Asiatic Engineers.

By C. A. MIDDLETON SMITH, M.Sc., M.I. Mech. E.
(Taikoo Professor of Engineering in the University of Hongkong).

The mail that has just arrived—August 2nd—brought the usual batch of papers from England. British engineers in Asia invariably glance through the technical journals first of all. They then read about current doings "at home." They are interested, not only in technical progress, but they want to know what people in authority in England have said about that part of the world where they live. In some parts of Asia the first news of political changes in the district appears in the journals that have arrived from "home."

In the issue of The Engineer that has just come to hand is a contribution from the Vice-principal of the University of Birmingham entitled "The Training of an Engineer." It is nearly thirty years ago that the writer was appointed as an assistant to Professor F. W. Burstall in that University. We have never lost touch with each other. During my last "long leave" in 1927, we had many conversations about training engineers.

With practically all that Professor Burstall wrote in his contribution to The Engineer, one of his friends now in Hongkong agrees. The training needed for a professional engineer to-day is different from that which was suitable fifty years ago. Workshop training is valuable—indeed, essential—for a mechanical engineer; but the trouble with commercial organisations in the past has been that they have not provided training. There has been the fetish that five years spent in the shops means learning—"gaining practical experience." The apprentice is left to "pick up" his knowledge. In many cases he simply wastes his time. The instruction in a commercial workshop for would-be engineers should be

as carefully thought out and supervised as the course of instruction in theory. If that is done an intelligent youth can learn in two years more than normally he would "pick up" in five.

In the universities, as Professor Burstall suggests, we do adhere too strictly to rules laid down by Rankine, Unwin, and others of a former generation. We also must adjust ourselves to new conditions. Professor Burstall's article, and the interesting editorial comment on it in the same issue, considers primarily the training of British engineers. There is also the problem of training Asiatic engineers. That is important to British manufacturers. Asia is now just beginning the great transformation that changed North America in the nineteenth century. That may, or may not, affect the fortunes of manufacturers of machinery in Britain. It is proposed to explain why it is so important for them to be interested in Asia.

The last mail from England brought a report of two broadcast—B.B.C.—talks. One was given on June 19th by Mr. Vernon Bartlett. He made the following statement: "We are beginning slowly to realise that those people who said that the most important event of the last twenty years has not been the World War, but the awakening of the Far East, were not talking nonsense." He referred also to the rapid road construction now going on in China.

On the previous day Sir John Simon, over the wireless, said: "We Britishers should never forget that it is the teachings of our own political philosophy, the spread of a knowledge of our own literature, which have developed the powerful forces in India which go by the name of the Nationalist movement." Sir John's words are applicable also to other parts of Asia, and especially to China.

The Engineer in Asia.

Sir John did not mention the effect of the work of the engineer in Asia. Yet it cannot be denied that the introduction of new methods of transport—the railway, the motor vehicle, and even the aeroplane—and rapid communications, such as cables and wireless, have had a profound influence upon Asiatic minds. The material benefits due to irrigation and other engineering works, carried out either by or at the suggestion of Britishers in Asia should not be overlooked. If the British withdrew from India to-morrow the engineering works would be a lasting monument to their labours. In Japan the country has been transformed by applied science in recent years.

It seems only fair that, as we British have taught Asiatics our political philosophy, and introduced them to our literature, we should show them how they may develop the natural resources of the countries they inhabit.

What has happened is this. We have introduced them to new ideas of life, to a much higher standard of living; we have not yet shown them clearly how to obtain that standard. The main cause of the "unrest" in Asia is that well-meaning Europeans and Americans have encouraged young Asiatics to absorb Western knowledge, but have not encouraged or trained them to develop the natural resources of their own land. Only applied science can do that. Asiatics have read all about the French and American revolutions and have jumped to the conclusion—not uncommon in Europe—that new laws will raise the standard of living.

This so-called "Nationalistic movement" all over Asia is of great importance to engineering firms in Great Britain. For better or for worse, Asiatics have got hold of the idea that Europeans want to exploit their labour and obtain all of the benefits that will accrue from the development of the natural resources in their country. That is altogether wrong, so far as British engineering firms are concerned. They want trade with Asiatic or any other countries. They desire to sell their products. Although in the past, orders may have come through the initiative of their own countrymen on the spot, it is obvious that, as each year passes, the direct buyers will be Asiatics. For it is a definite outcome of the new outlook in Asia that the natural resources of that vast continent will be developed by the natives of the various countries that compose it, and not by foreigners.

The problem of the next fifty years is to raise the standard of living in Asia. It is the old problem of making two blades of grass grow where formerly there was only one. It can only be solved by those trained in applied science.

Mr. Vernon Bartlett, in his wireless talk, pointed out that in 1921, there were only about a hundred miles of motor roads in China, whereas to-day there are twenty thousand. In Canton, the most populous city in China, there was not a wheeled vehicle twenty years ago—the streets were too narrow, even for a man-pulled rickshaw. Five years ago there was not much evidence of progress. To-day, Canton has wide roads and cars and buses, automatic telephones, broadcasting, as well as an elaborate town-planning scheme at work. Practically all of it has been carried out by Chinese engineers. These have received their training in Europe, or the United States.

The mentality of Asiatics is different from that of Anglo-Saxons. In general they like abstract subjects better than science. They place a far greater value on book learning. It is doubtful whether engineering could compete with such subjects as philosophy or law in a university for Asiatics, but for the general idea that there is money to be made out of a knowledge of applied science. In China the desire to make money may be said to be the ruling passion of the people. That is why engineering, as a profession, attracts young Chinese. They think there is money in it. We can honestly encourage them to believe that.

Engineering in the Interior.

The fact that the electricity supply service, formerly owned by the Municipal Council of the International Settlement of Shanghai, was recently sold to a syndicate of American and British financiers for £10,000,000 (ten million pounds sterling) is proof that there have been engineering developments in the Far East during recent years. It is probable that a similar syndicate would pay a very big price for the electricity supply service for the British Colony of Hongkong. But the possibilities of a load for Hongkong are almost trifling beside that conceivable for the adjoining Chinese province of Kwangtung. There are sixty million people, of great industry, living in that most fertile part of the world. Within a radius of 50 miles of Canton city there must be about 20 million people, many of them engaged on industries other than agriculture. The silk industry, alone, if organised so that applied science and electricity supply were used would absorb a great deal of power.

If one can imagine some body such as the Electricity Commissioners of Great Britain, backed by the same firm Government and financial resources that support the Commissioners in Britain, able to work in Kwangtung, the demand for equipment would gladden the hearts of manufacturers of electrical plant and accessories in Great Britain.

It is clearly greatly in the interests of British engineering firms that ideas about electricity supply and the use of mechanical appliances should be placed before Asiatics. If as much time and thought had been spent in such propaganda as has been devoted to the spread of new political ideas, Asia would be more contented to-day.

Kwangtung is but one of the eighteen provinces in China. It is the one best known to the writer, who has lived on the edge of it for eighteen years and has travelled in it. Except on the coast, there is very little industrial engineering development, on any scale, in China. Japan has developed her natural resources, and those of Korea and Manchuria, through the initiative of Japanese engineers. They were mostly trained in their own country by British professors. The names of Ewing, Ayrton and Perry spring to the mind in this connection.

There is one point that must be emphasised. It is this. Whether the young Asiatic is to be trained as an engineer, a doctor, or anything else, he should not leave Asia until he has graduated.

Encouraging young Chinese, Indians, &c., to go to Europe or America as undergraduates has created trouble.

The Civil Engineer.

In every country the work of the civil engineer precedes that of the mechanical and electrical engineer. At present the demand for Chinese civil engineers seems to exceed the supply. There is a real development of roadmaking, &c. In places on or near the coast, such as Hongkong, Canton, Amoy, Shanghai and Tientsin, there has been recently great activity in the construction of reinforced concrete buildings. Some European engineers have been engaged upon the work, but during the last ten years it has been noticeable that a number of Chinese graduates have been actively employed as architects and engineers.

There seems to be little difficulty about training civil engineers in Asia. In the University of Hongkong, we have found that graduates in that branch of engineering readily find employment. There is a demand for their services immediately after graduation. No doubt they would be more efficient if they had two or three years' practical experience under a European engineer. We have recently been able to arrange that some of them shall serve, at a living wage, for two years in the local Public Works Department. They will thus gain experience of municipal engineering work under British engineers. That should enhance their value for work in a Chinese city. It would probably be of advantage if some Chinese civil engineering graduates obtained practical experience in England; but that is not imperative. It is difficult to formulate a scheme, and in any case there is no difficulty in employment for the Chinese civil engineer.

Mechanical Engineers.

It is, however, concerning the training of the Asiatic mechanical engineers that we are most anxious. These men are needed if mechanical and electrical goods are to be used in Asia. How can we train them? How encourage them to offer themselves for training?

For many years the writer has advanced a thesis which has, at times, been severely criticised. It has even been called "immoral" by one British Government official. Despite that label, it will be again put forward. It is as follows.

The output of the workshops of Britain can only be increased by stimulating a demand for the products abroad. In Asia—especially in China—there is a large potential market for those products. That market can only be developed by training Asiatic engineers. It is to the interest of Great Britain that they should be trained in British standards.

There is no difficulty about the training in the theory of technical subjects in Asia. There are now universities in India, China, and Japan, where engineering subjects are taught. The difficulty is to arrange the practical training for Asiatic engineers.

College Workshops.

Our experience is that Chinese students no longer object to do manual work. Whatever may be urged against workshop practice in British universities, it is invaluable for Asiatics. It enables them to gain confidence. It is a good—an indispensable—introduction to the commercial workshop. The Asiatic student, of the professional class, still has the "caste" idea about manual labour. The college workshop is essential if only as a method of overcoming that prejudice. Once the student has been through the college workshop he changes his ideas about manual labour. He sees that he can learn about some things only by using his hands. The college workshop is, however, not enough. It cannot give commercial experience. The graduate should go to England for that.

We have, therefore, tried to make arrangements so that engineering firms in Britain will take graduates of the University of Hongkong into their works as student apprentices. In certain cases we have been successful. It is obvious that if an Asiatic of some standing spends two years in a works in England he will be likely to send orders for machinery to that works later on. It may not be so obvious that the young Asiatic may be trained to represent the British firm in his own country. And it is the Asiatic graduate engineers who will obtain the order for machinery. They know the habits of their people; they can talk both English and their own language; they can travel where it is unsafe for a white man to go; and they are far less expensive to maintain than a white man.

What is needed is some central organisation that will arrange all details. There is a great loss of time if we, in the University of Hongkong, write round to firms in Britain to know whether they will take Chinese student apprentices, and on what terms.

In this connection the writer has approached the Federation of British Industries, the Commercial Counsellor at the British Legation at Peking, and others likely to be interested in British trade in China. Up to the present no arrangements such as those suggested above have been made; the case of each graduate who desires to go to England is considered on its merits. It is only fair to say that the question of making some permanent and general arrangement for the placing of Chinese with firms in England was gone into very thoroughly a few years ago by the Department of Overseas Trade, in consultation with experts out here. As a result the Department decided that each case would, as far as possible, be considered on its merits, giving particular consideration to such points as the opinion of the Department's representative in China, as to whether the student was likely to obtain a good position on his return to his own country, and to the question as to how far it was possible to afford such a student a really practical training. The first point it is often very difficult to determine, while the second is said to be a matter for the firms in England themselves. The Department does not put pressure on British manufacturers to accept students, but is, of course, willing in every way to facilitate their doing so.

With all due respect to the Department of Overseas Trade, this system seems altogether wrong to those who train Chinese students. It wastes too much time. While all of these elaborate inquiries are going on the anxious graduate is marking time. After a few weeks he gets tired of hanging around and he goes off to the United States.

Engineers in Demand.

Our experience with Chinese engineering graduates is that, whenever possible, they are anxious to go abroad for further experience. After the expense of four years at a university we cannot expect them to spend more than two years on further training. They seem to prefer to take up post-graduate work in a foreign university rather than to enter an engineering works. In the present state of China this is unfortunate, because in an undeveloped country practical experience is of more value than high academic attainments. We find, also, that although our own graduates prefer the idea of going to England, yet the facilities offered them in the United States are so attractive that they soon discover it is much easier to go to that country. We have had several cases of Hongkong University engineering graduates who have received a living wage and valuable practical experience in workshops in the United States. The conclusions which the writer has formed after thirty years' experience of teaching in universities, eighteen of them having been spent in training Asiatics—Chinese, Indians, Japanese, Siamese, &c.—for an engineering degree, are as follows:—

(1) The old apprenticeship system of five years in an engineering works was, and is, a fetish with many British professional engineers.

(2) The new system for graduate apprentices as

arranged by Messrs. W. H. Allen, of Bedford, and other firms in England, &c., is excellent.

(3) College workshops are essential in engineering schools in Asia.

(4) The curriculum in Asiatic engineering schools should be amended so that far more time is given to college workshops and laboratories and less time to higher mathematics and such academic matters as the $\theta\varphi$ diagram.

(5) Asiatic professional engineers should obtain school and university education in their own country.

(6) It is essential, for British trade purposes, that Asiatic graduate engineers be encouraged to go to England for two years' practical experience.

(7) Some central organisation such as the Federation of British Industries should be actively concerned in encouraging Asiatic engineers to go to England.

The above remarks are, of course, applicable only to the training of professional engineers. The problem of the Asiatic artisan is one that demands, and can only receive, attention in his own country.

The difficulties of the British and the Chinese in China are very great. But we need not despair. The best news that has, for many a long day, come to the British in China is that an economic mission is coming to the Far East on behalf of British trade, and, thank goodness, the engineering manufacturers have a representative as a member of that mission.

The Fusion Welding of Pressure Vessels.

In the "Technical Report for 1929," issued by the British Engine Boiler and Electrical Insurance Company, Ltd., a continuation is to be found of the account of the researches which the company's staff has recently been making into the fusion welding of pressure-containing vessels. It may be recalled that in our issue of September 13th, 1929, we summarised the results of the investigations conducted up to that date, and that last March Mr. L. W. Schuster, one of the company's engineers, read a paper before the Institution of Mechanical Engineers, in which the significance of the results was discussed. In his paper Mr. Schuster included some suggested rules to govern the design and construction of fusion-welded non-fired pressure vessels. A research committee has since been appointed by the Institution to consider the subject, and accordingly, in the company's report for 1929, no further proposals are made concerning the regulation of design and construction, attention being confined to the results of the latest experiments on welding which the company has carried out.

The report this year opens with some particulars of three welded air receivers which exploded. The details are interesting, but perhaps the most striking fact brought out is the greatness of the energy which can be present inside a vessel containing compressed air. One of the vessels which failed was 12in. in diameter and 4ft. 2in. in length. Its shell plate and end plates were ·09in. thick and it was designed for a working pressure of 100 lb. per square inch. It failed under a pressure of 50 lb. One end was blown out and projected through the roof, and the receiver was dislodged from its supports. It is calculated that at 50 lb. pressure the receiver contained 36,500 foot-pounds of energy. This energy, if it were applied entirely to the receiver end, weighing 3 lb., would, neglecting air resistance, have projected it to a height of 2·3 miles with an initial velocity of 600 miles an hour.

Surveying the practice of fusion welding for pressure vessels on the Continent, the report calls particular attention to the progress which has been made in Switzerland. The confidence in fusion welding in that country is so strong, thanks largely to the work and control exercised by Monsieur Hoehn, of the Swiss Steam Users' Association, that welded circumferential seams without butt straps are to be found on steam boilers 6ft. in diameter and carrying a working pressure of 150 lb. per square inch. It was ascertained that of all boilers and pressure vessels for working pressures up to 400 lb. manufactured in Switzerland and authorised for installation, 95 per cent. are fusion welded.

The strength of plate which should be used in welded pressure vessels is a question on which there is a division of opinion. Six qualities of plate, namely, of wrought iron, Armco iron and steel with 0·1, 0·22, 0·3, and 0·6 per cent. carbon, were welded with a single-V butt weld. The quality of fusion and the change occurring in the plate metal were noted in each case. It was found that there was nothing to choose between the quality of the fusion obtainable with any of the plates and that there was no intrinsic objection to any of the plates used being welded, provided the welded plate is normalised and a good quality of welding rod with the requisite strength is employed.

Similar tests were carried out with a 3 per cent. nickel steel plate, a material which is coming into use for certain pressure vessels. The welds were made by different manufacturers and by both the metallic-arc and oxy-acetylene processes. The results varied very greatly. In one case, with a metallic-arc weld and using a welding rod which was both nickel-plated and covered, no indication was obtained in support of the view that nickel is detrimental to welding and the structure was no poorer than that found in a plain carbon steel. In another case, in which the plates were welded by the oxy-acetylene process using a dead mild steel filling rod, the weld was so defective that no tests were carried out on it.

The atomic hydrogen process is a method of welding by which an intense local heat is obtained at the part to be welded. The source of heat is a short electric arc played between two thin tungsten electrodes. Hydrogen at a pressure of 1 lb. per square inch is forced through tubes surrounding the bases of the electrodes and a flame of atomised hydrogen is projected on to the work. The resultant temperature is higher than that obtained by an arc in air. The metal is not deposited electrically, the arc merely being a means of heating the filling rod. The jets of hydrogen incidentally protect the molten metal from contact with the atmosphere. The arc is struck in the hydrogen at a pressure of 300 volts, but as soon as it is established the pressure is choked down to 70 volts. Tests were made to gauge the suitability of this process. The results obtained were in some measure affected by the fact that the plant employed was experimental and possessed insufficient power. It is, however, recorded that the weld metal was of excellent quality and that the bend tests were highly creditable. No benefit was derived from heat treating the welded specimens. In fact, parts of the weld which originally showed a superfine structure were coarsened by such treatment.

A considerable amount of attention was paid to the effect of the composition and covering of the electrode on the quality of the weld obtained. Four electrodes were tested. They contained manganese in varying proportion. Three of them were coated with a light deoxidising wash, while the fourth was a bare wire. It was found that the light wash assisted penetration and that the quality of fusion was worst with the bare wire electrode. Tensile tests showed that the strength was reduced as the carbon and manganese content of the weld metal decreased. In spite of the fact that low-carbon electrodes are generally considered highly desirable, the tests did not show porosity or other fault arising from the carbon being too high. While in general the lightly washed electrodes gave better results than the bare wire, they did not come up to the standard of what is possible with a high-class coated rod.

A note is appended to this section of the report which will perhaps surprise some users of Swedish charcoal iron electrodes. The term Swedish charcoal iron, it is stated, appears to be much abused. On many occasions, when makers of welded vessels have been under the impression that they were using this material, examination by the insurance company has disclosed that they have "been grossly misled by their suppliers." Particulars are given of four so-called Swedish charcoal iron electrodes. One was simply a mild steel containing 0·1 per cent. of carbon. Two of them showed a band of steel. The fourth had a banded structure which had apparently been given a decarbonising treatment to make it represent iron. It may console those makers who have been misled in this direction by their suppliers to learn that the company's remarks do not necessarily imply that the material actually used leads to a weld inferior to that produced by Swedish iron. Their consolation in this respect must, however, be considerably tempered by the fact that the company has yet to learn that Swedish iron has any special virtue as a means of obtaining a satisfactory metallic arc weld.

Tests were made on the effect of increasing the manganese content of a good quality of electrode covered with a high-grade flux. In general the quality of the weld improved with increasing manganese content in the electrode, but the ease of welding diminished.

The studies, the beginning of which was recorded in last year's report, on variation of the mechanical properties of butt-welded joints according to the details of manufacture were continued. To begin with, further attention was directed towards determining to what extent the properties of the weld were affected by variation in the strength of the parent plate. The results of the tests appear to have been influenced by several arbitrary factors, but it would seem that in general the weld metal derives a definite increase of strength from an increase in strength of the plate metal which it is used to unite, and that in some cases the apparent strength of the weld metal may be raised above its natural value. Tests under the same heading were conducted to determine the effect on the weld strength of variation in the distance apart of the vee edges of the two united plates and of variation in the angle of the vee. It was found that when the gap between the vee edges was half an inch or less the strength of the welded joint was greater than the strength of the weld metal tested separately. The effect of the angle of the vee was examined by testing plates butt welded with asbestos-wound rods, the angles of the vee being 45 deg., 70 deg., 90 deg., and 120 deg. The 70 deg. and 90 deg. vees yielded equally good results, but the 90 deg. vee is recommended because of the increased ease with which the weld can be effected. The 45 deg. and 120 deg. vees were defective.

The effect of changes in the welding current on the properties of metallic-arc welds was studied. With an asbestos-wound electrode and a vee of 70 deg. and employing a welding current ranging from 60 ampères to 180 ampères, no marked tendency of the results to be affected by the welding current was observed. The current used in these tests was direct current. A subsequent test was made at 80 ampères, using alternating current. The result showed that, although there were certain decided advantages in using direct current, they were not necessarily reflected in the mechanical tests.

In last year's report experiments were detailed, all of which tended to show the inferiority of carbon-arc welds when compared with other fusion processes. Further tests were conducted to check this conclusion. Plates $\frac{3}{4}$in. thick were welded with continuous current arcs of varying length, the filling rods being of Swedish iron and of 0·6 per cent. carbon steel. Change in the length of arc was found to have no effect on the toughness of the welds as measured by the Izod test. Normalising did not improve the toughness. The use of a carbon steel filling rod improved the toughness slightly. The company has, the report states, never found a weld of this class that did not lack ductility and toughness.

The inferiority of a weld in which the weld metal is deposited from one side of the plate only was further studied. The results recorded in last year's report were amply confirmed. It was found that in a single-vee metallic-arc weld with the metal deposited from one side only the penetration of the weld metal to the bottom of the vee could not be guaranteed to be perfect, however good the workman might be. Such a joint might behave admirably under a hydrostatic test, but that fact would provide no criterion of how it would stand up to the breathing stresses of service. For this type of weld to give certainty of penetration it would seem, the report states, necessary to have recourse to automatic welding. This form of welding, so far as the company knows, has not been applied to pressure vessels in this country, although it is possible that developments in that direction may take place in the near future.

A lengthy section of the report is devoted to a discussion of some experiments undertaken to determine the cause of contaminated structures found in welds. The section is largely of metallurgical interest. The general conclusions arrived at are in summary as follows:—

(*a*) Nitrogen is undoubtedly the cause of the apparently high-carbon content of welds made with bare wire electrodes or electrodes of which the covering is inefficient in shutting out the atmosphere.

(*b*) The toughness of weld metal containing nitrogen is increased by heat treatment.

(*c*) A weld made in an atmosphere of oxygen with a bare wire electrode does not show the needles which are commonly found in normalised welds made in the atmosphere. If the atmosphere is changed to one of nitrogen, all the necessary constituents for the production of the needles exist.

(*d*) The number of needles present in welds made in the atmosphere is affected by the length of the arc. No needles were found when the arc length was $\frac{1}{4}$in. They increased in number until at an arc length of $\frac{1}{16}$in. they were plentiful.

Brief notes on the welding of cast iron by means of non-ferrous alloys and on the welding of copper plates, also by means of an alloy, conclude the company's report on welding.

BONDING NEW CONCRETE TO OLD.

At many points round our coasts evidence is to be seen of the futile efforts made to stop the erosion of the land by means of concrete retaining walls. In many such instances the fault lies, not so much with the power of the waves or the dimensions of the wall, as with the manner in which the wall was constructed. It is in the joints between the sections in which the wall must inevitably be cast that the weakness lies. The great importance of obtaining a strong bond between sections of concrete, not only in sea walls, but in many other types of structure, is emphasised in a Building Research Bulletin published recently by the Department of Scientific and Industrial Research. Experiments have been conducted to determine the precautions which are necessary in order to secure a satisfactory bond between new concrete and concrete which is a few hours, a few days, or many days old. If concrete is to be bonded to concrete which is not more than four hours old the "laitance" layer and the porous concrete immediately below it must be removed from the old material in order to obtain a good bond. The laitance layer is the film of very fine cement which, in the presence of an excess of water, forms, on drying, a chalky mass of non-coherent material. The new concrete should be added immediately this top layer has been struck off. If the old concrete is more than four hours, but less than three days, old the laitance layer should be removed and the surface wire-brushed and washed. A $\frac{1}{4}$in. layer of cement mortar of the same composition as the new concrete, but with the large aggregate omitted, should be applied to the old concrete before the new is placed on it. If the old concrete is more than three days old the surface should be chipped away, brushed and rinsed. Thereafter a slurry of neat cement should be applied to the prepared surface, to be followed by a layer of cement mortar before the new concrete is placed in position.

Electricity Supply and Flue Gases.

The extension of the utilisation of electric energy for domestic and industrial purposes has caused those engineers who are concerned with its production to consider the relative merits of its local generation in the centre to be served, or, alternatively, the provision of a power-house in a more isolated district, where amenities may not be so seriously disturbed by the operation of the power-house, as it is now known, and the transmission of the power to the centre of consumption.

The controversy was brought to a climax last year by the decision to build a large power station at Battersea for supplying the area of the London Power Company. That station will probably have an ultimate output of 400,000 kilowatts, and it was not unreasonably feared that a nuisance would be caused by the emanations from the chimneys, for, as must be the case in this country, coal will be the fuel used to provide the power.

The combustion of ordinary coal must, of necessity, result in the dispersal in the atmosphere of sulphurous and sulphuric compounds which are deleterious to materials and health alike, and when it becomes

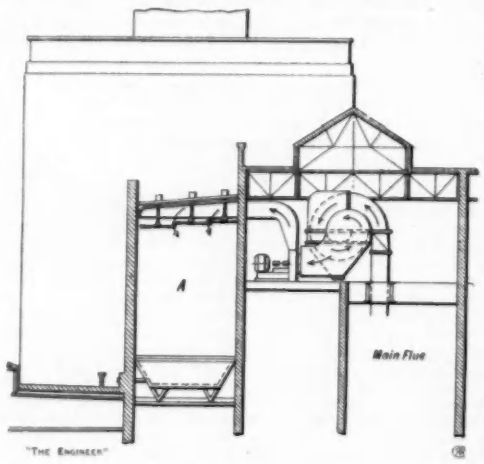


Fig. 2—Cross Section

necessary to burn some 500,000 tons of coal per annum—the estimated consumption of the first half of the Battersea station—in a residential district for the purpose of getting central electricity generation, or, alternatively, generating in the country and transmitting the energy over, say, 20 miles, it becomes necessary to consider the relative economies of suffering the loss inevitable in transmission and the expense of eliminating the nuisance caused by a local power station.

It is hoped that a scheme evolved by Dr. S. L. Pearce, of the London Power Company, in conjunction with certain eminent chemists, will enable a large power plant to be put up anywhere without being offensive, provided that there is a reasonable stream of water near by, and even without that facility if large settling ponds are available.

Like all all other problems of this nature, the matter settles down to one of economics, and we understand that there is fairly conclusive evidence that the chimney gases from the Battersea station will be at least 95 per cent. free of noxious fumes, and the cost of their cleaning will not amount to more than 1s. 6d. per ton of coal consumed, even if resort is made to the partial use of alkaline wash-water, a matter which is dealt with later in this article. On the other hand, if the plant were installed down the river, about 20 miles, away, the losses of transmission would be equivalent to at least 4s. 6d. per ton of coal burned at present prices.

The Battersea plant will, of course, be in a favourable position in regard to the disposal of wastes, as there is a good flow of water in the Thames, and the effluent from the gas-cleaning plant will be diluted both effectively and on a large scale by the condenser cooling water, with which it will be mixed. The cooling water will amount to some 400 to 500 tons per ton of coal burned, while the effluent from the gas-cleaning plant will be about 25 tons per ton of coal, thus giving a dilution factor of some 20 to 1. The sulphates may be considered innocuous in the river, as they will be neutralised by the natural hardness of the water, and as regards the sulphites, which might rob the river water of its dissolved oxygen, the Power Company has given a definite undertaking to the London Port Authority to restrict them to 0·5 grains per gallon, and to secure this result the necessary treatment tanks will be provided.

In the elimination of sulphur from flue gases, it is natural to fall back on the use of alkaline or lime sprays, but either of these naturally increases the cost of the treatment, so Dr. Pearce and his colleagues have been concentrating their attention in experiments on the use of plain water for washing purposes, and have, we are informed, succeeded in washing out over 92 per cent. of the sulphur content.

The plant necessary for dealing with the flue gases from such a large station is necessarily bulky, and its extent may be gauged by the fact that, while the chimneys at Battersea will be 300ft. high, half that height will take the form of the towers for the gas treatment. Nevertheless, the architect's drawings for the station show a pleasing and dignified outline.

The principle involved in the cleaning of the flue gases is a combination of cyclonic extraction of heavy ash, the washing out of fine ash and sulphur compounds, and the final extraction of the moisture containing the impurities.

Adjacent to the main boiler flue system there is to be a long chamber, marked A in the diagram, taken from Dr. Pearce's patent specification. This chamber will be divided up into sections, one for each boiler, or six, as is shown in Fig. 1, separated by baffle scrubbers C. The flue gases are to be sent into this chamber by induced draught fans arranged overhead, which will suck through cyclones for the extraction of the more heavy grit, as shown in Fig. 2, and discharge through the ceiling of the chamber A over baffles arranged to make the flow as even as possible. In these chambers, the rate of flow of the gases will be very low, and they will be thoroughly drenched by sprays E of hot water. In this way the remaining solid matter will be precipitated into troughs B at the bottom of the chamber, while some of the sulphur will also be eliminated. The whole of the gases flow towards the left—as shown in Fig. 1—and arrive at the top of the tower-like stack beneath the chimney proper in the downcomer D. In this duct they will be subjected to a thorough drenching by cold water from the sprays F. At the bottom of the downcomer, the gases will be abruptly turned upwards, with the object of precipitating the carried moisture, and will go up through the rising ducts towards the base of the chimney, where they may, if necessary, be subjected to a further douching with either plain water or alkali.

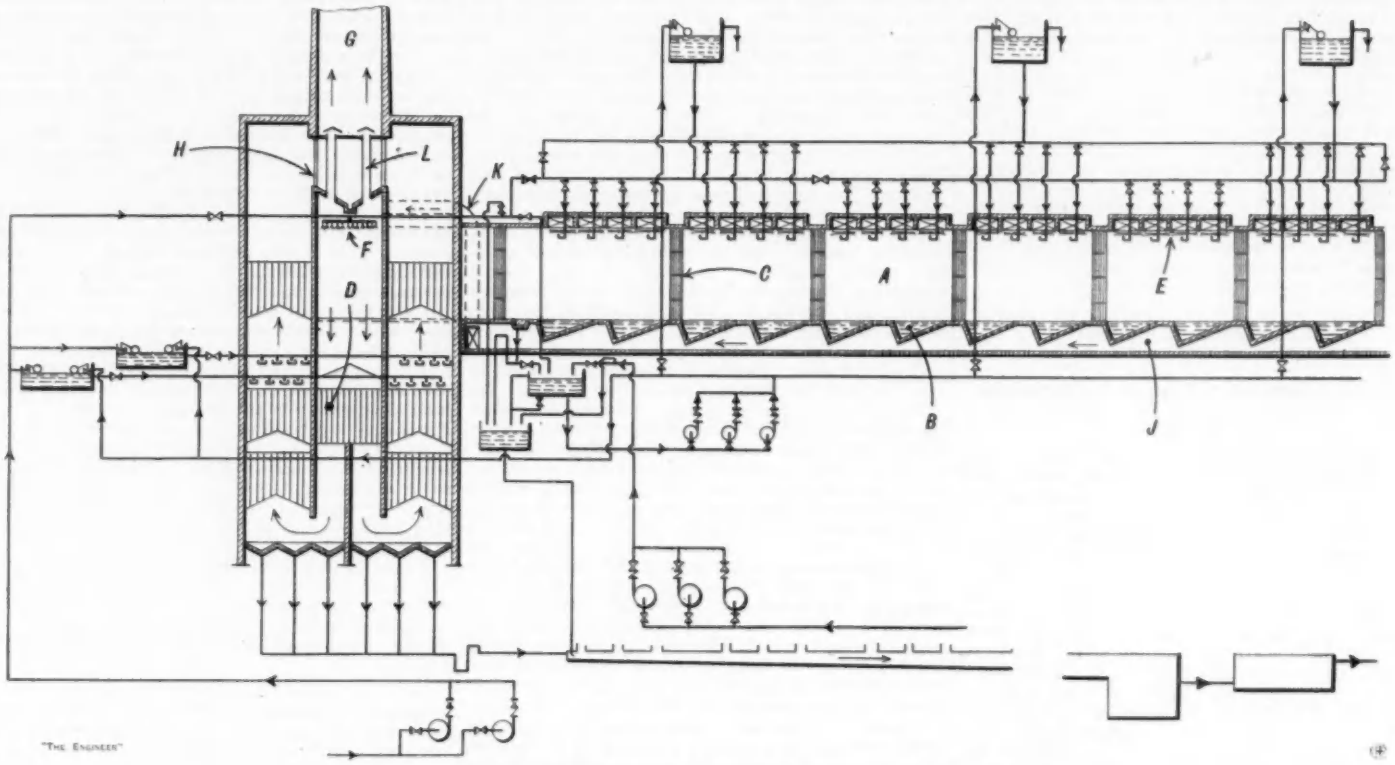


Fig. 1—Dr. Pearce's Arrangement for the Cleansing of Flue Gases

Both the rising ducts and the downcomer will be filled with a mass of thin iron, either in the form of tubes or sheets, having the maximum possible surface, to act as a catalyser for the conversion of sulphur dioxide into sulphates.

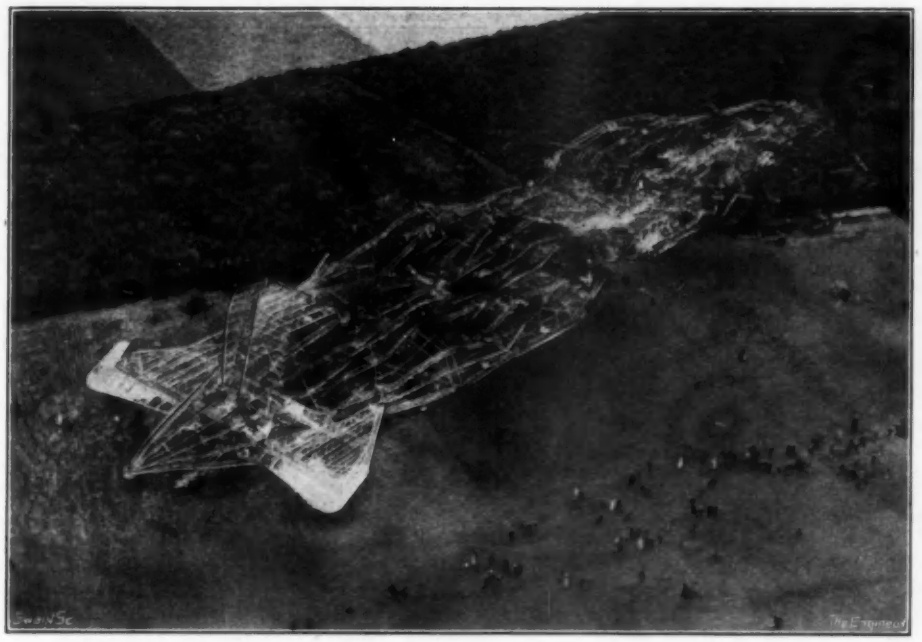
It is anticipated that the first parts of these catalysers will tend to waste away, so arrangements will be made for their convenient removal and replacement.

Arrived at the top of the rising ducts, the gases will pass through moisture-eliminating baffles H and go into the bottom of the chimney G. The gases might still be supersaturated, and consequently show a "feather" at the top of the chimney, so they are to be superheated at the base in the following manner:—Air drawn off the hot tops of the boilers by fans will be passed along the flue J under the chamber A, where it will be further heated, and then sent by way of the trunking K and the vents L into the base of the chimney. In this way, not only will the emission of visible steam from the stack be avoided, but also the boiler-house will be cooled.

COPPER SMELTING PRACTICE.

As an aid to development in metallurgical practice, the first of a series of conferences of managers and engineers of copper works operating reverberatory furnaces has been held, with promising results. A discussion as to methods of charging showed that at different plants the furnaces are charged along the side, at the centre, and at intermediate points, with varying practice as to depth of bath. In some cases the charge is wet; in others it is heated to varying degrees. The economic conditions involved may be studied with some idea of adapting methods to various fields, or arriving at some general conclusions. While the conditions at any one plant may be established by the system of charging and the nature of the charge, they are affected materially by the temperatures maintained. Combustion therefore was an important item in the discussion, and was treated as the principal means of obtaining the results which are shown by the metallurgical records. Costs of fuel is one of the principal items in working expenses, so that the study of furnace construction and operation must be based upon a study of fuels and combustion. Oil, natural gas and pulverised coal are among the fuels used, while a description of the use of preheated air led to a comparison with the operation of open-hearth steel furnaces. Loss of copper in the slag is a familiar problem, as is the loss in dusting from flotation concentrate. As to slag-forming constituents which affect the loss of copper in slags, the main problem is the formation and removal of magnetite, the control of which is largely a matter of metallurgical skill. This control is correlated with methods of charging and firing and depth of bath.

WRECKAGE OF THE "R 101"—AERIAL VIEW



The Airship Disaster.

Above and on page 400 we reproduce three photographs showing the wreckage of the "R 101" after she crashed and caught fire at Allonne, a few miles south of Beauvais, France, while on her first voyage from Cardington to Karachi. In view of the discussion which must inevitably arise as to the wisdom or folly of continuing the long-sustained efforts to perfect the airship, we give below particulars of previous disasters. Accidents to airships of the non-rigid type are not included.

1909. September.—"Republique," French. Exploded in the air; 4 killed.
1910–11.—Four Zeppelin vessels destroyed by storm or fire.
1911.—"Mayfly," British. Back broken during launching.
1912. July.—"Akron," American. Exploded on attaining excessive height.
1913. September.—Zeppelin "L 1." Wrecked; 15 killed.
1913. October.—Zeppelin "L 2." Exploded; 28 killed.
1914. April.—"Citta di Milano," Italian. Descended out of control and exploded on the ground while being deflated.
1914. June.—Korting-Wimpaning, Austrian. Collided with aeroplane; 9 killed.
1919. July.—"C 8," American. Exploded as a result of heating by the sun; 75 killed.
1919. July.—"N.S. 2," British. Struck by lightning; 9 killed.
1921. August.—"R 38," British. Broke in the air; 44 killed.
1922. February.—"Roma," Italian. Exploded.
1923. December.—"Dixmude," French, formerly "L 72," German. Wrecked at sea; 53 killed.
1925. September.—"Shenandoah," American. Broke in the air; 14 killed.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

FOREIGN TONGUES.

Sir,—I crave a little space to follow up the very interesting point raised by your correspondent, Mr. L. A. Ware, of New Orange (U.S.A.) in your September 26th issue.

As Mr. Ware states, it would certainly be profitable for engineers and scientists in all countries to consider seriously the possibility of using Esperanto as a medium of communication among them.

There is only one difficulty in the way, and that is the compilation of technical dictionaries in Esperanto and the languages of the countries concerned, and to produce these would involve very close collaboration between the several countries through their governments, engineers and scientists, for, unless every term were clearly defined, both in Esperanto and the ordinary language, confusion would be sure to result.

While on the subject of technical dictionary-making, I would like to point out that no really reliable dictionary in any branch of technology can be satisfactorily compiled by one man. It needs the very closest co-operation between specialists in the several countries, with numerous consultations to define correctly any doubtful terms. This, of course, costs a great deal of money, and no publishing firm can be expected to bear the expense themselves, and here, I think, governments, technical societies and private firms should assist.

Too many publishers produce isolated dictionaries which never cover the ground fully like, say, the Schlomann series published in Germany, and, although fourteen or fifteen volumes of these have been issued to date, they have barely covered half the possible field, and, I understand, certain volumes have had to be held up for lack of support. The same difficulties would arise in the compilation of Esperanto dictionaries, unless the governments of all countries were agreed on the necessity of producing them and were willing to support their production. What a fruitful opportunity for the League of Nations, which seems to be spending a lot of money on objects much less worthy!

E. S. Hodgson.

North Shields, October 4th.

The Canadian Good Roads Association.

The seventeenth annual Convention of the Canadian Good Roads Association was held at the Chateau Frontenac, Quebec, from September 16th to 18th, with an attendance of about 500, including many delegates from Great Britain and the United States. Premier Taschereau, in an address of welcome, enlarged upon what the Provincial Government had done in the construction of good roads, on which the province had expended 100,000,000 dollars, while all the main roads were being built and maintained by the Government. The Hon. H. G. Carroll, the Lieut.-Governor, also welcomed the delegates. Major F. C. Cook, D.S.O., M.C., representing the British Government, declared in reply that, in England, the road problem was one of modernisation, whereas that of Canada was largely pioneering. Luang Prinya Yokavibul, a delegate from Siam, said that his country, like all others, was concerned over the road problem, as the people were no longer satisfied with the slow method of travelling by boat.

A number of addresses dealing with conditions in the different provinces, was then delivered by provincial Ministers and highway officials. The Hon. J. E. Perrault, Minister of Highways in Quebec, discussed the progress which that province had made in highway construction during the last twenty years, and stated that it had involved the building of more than 13,000 miles of permanent highway. He pointed out that to-day wider roads were needed to permit higher speeds and greater safety in the movement of the growing flow of traffic. Mr. J. T. Sharpensteen, assistant maintenance engineer of the Michigan State Highway Department, spoke on "Gravel Roads, Dust Layers, and Maintenance." A width of 18ft. seemed, he said, to be about the minimum for handling high-speed traffic with safety. A discussion followed on highway widths, lengths, gradients, and alignments.

In the evening of the first day addresses were given by the Hon. George S. Henry, Minister of Public Works for Ontario; Mr. W. Rees Jeffreys, of London, who spoke on "How the Constituent Part of the British Commonwealth can Best Co-operate to Develop their Road Systems"; and the Hon. W. A. McKeown, Chairman of the Board of Railway Commissioners, who discussed highway railway level crossings and the level crossing fund; while "Winter Highway Maintenance" was the subject of an address given by Mr. Alex. Fraser, chief engineer for the Province of Quebec.

The following officers were elected for the ensuing year:—President, the Hon. J. E. Perrault, Minister of Highways and Mines for Quebec; First Vice-president, the Hon. N. S. Lougheed, Minister of Public Work for British Columbia; Second Vice-president, the Hon. A. C. Stewart, Minister of Highways, Saskatchewan; Third Vice-president, the Hon. W. R. Hibbs, Minister of Public Works, Newfoundland; and Secretary-Treasurer, Mr. George McNamee, of Montreal. A board of nineteen directors, representing all sections of Canada, was also elected.

The Hon. A. C. Stewart, the retiring President, in his annual report, stressed the necessity, from the point of view of safety, for uniformity in highway signs, roadway and bridge widths, curves, gradients, and traffic regulations, and hoped that all the provinces would unite for that object.

Mr. S. L. Squires, Chairman of the Executive, presented a report much on the same lines as that of the President, and expressed the hope that all level crossings would be classified, and that those considered the most dangerous would be the first to go.

In the afternoon the delegates went for an excursion to Murray Bay, where the annual banquet was held in the evening.

On the closing day the proceedings of the first session were in the French language, Monsieur J. L. Boulanger, Deputy Minister of Highways for Quebec, occupying the chair. The principal speaker was Mr. Arthur Gaboury, of Montreal, Secretary-General of the Quebec Safety League, who spoke on "Safety Measures," urging the reduction in the number of licences as one of the means of lessening the alarming number of accidents. He referred to what had been done in England and elsewhere in that direction. At the closing business session, the Hon. P. C. Black, Minister of Highways for Nova Scotia, presented a resolution recommending the establishment of plants for the manufacturing of road-making machinery, which would give work to many now unemployed, and lessen the importation of so many foreign-made machines. The convention closed with an entertainment and dance in the evening.

SIXTY YEARS AGO.

The Siege of Paris by the Prussians began on September 19th, 1870. For a short time it interrupted the weekly letters of our correspondent in that city, but in our issue of October 14th we were able to resume them with a letter dated October 1st, which had been despatched from the beleaguered capital by balloon post. Two balloons, he reported, had crossed the enemy's lines. The second one really consisted of three balloons tied together. It carried 2 cwt. of letters and some special envoys. Another method was, however, soon put into operation for the despatch of letters. Letters not exceeding 4 grammes in weight were sent off in small free balloons in the hope, no doubt, that they would fall into friendly hands, and be forwarded to their destination. Our correspondent reported that although the inhabitants of Paris were cut off from all the world, they were not at all cast down. They would scarcely contemplate the chance of the enemy entering the city. The forces within the capital were, he said, stronger in number than the enemy without. The new army of the Loire would, it was reported, number 400,000 men. The people of the west were rising *en masse*, and would soon be marching to the relief of Paris. The enemy was believed to be short of ammunition and provisions. The Prussians appeared, in fact, to be drawing off, and for four days little had been seen or heard of them. The firing of the marine gunners in the outer ring of forts had been magnificent. Not a shot had been thrown away. Every one had been aimed with astounding accuracy, at distances of 3000 to 5000 yards. The franc-tireurs, mostly old soldiers, had rendered splendid service. They had recently blown up the tunnel at Saverne, near Strasbourg, and a bridge over the canal near the same place. Almost under the very nose of the Prussians, they had thereby severed the enemy's communications by rail and canal with Germany. A monster gun had been completed at Nantes and tried at sea. It could carry a round shot weighing 3 cwt. to a distance of over 5 miles, and would probably be brought to Paris by the army of the Loire. The National Guard in Paris now numbered 400,000, and more battalions were being formed. The Champs Elysées, the Gardens of the Tuileries, the open space behind Notre Dame, and the Champs de Mars had all been made into great artillery parks and throughout the day the horses stood harnessed to the *fourgons* ready to take the guns to any threatened point of the circle round Paris. Several small engagements had taken place round the city, with the object of improving the defending army's position. Success had attended some of these operations, but from others a sad train of wounded had returned. The Prussians were again being accused of using explosive bullets. Altogether, the Parisians found it in their hearts almost to pity the poor Prussians faced with the prospect of eating their Christmas dinner in the wilderness to which the surroundings of Paris had been reduced. Still, the capital was already running short of charcoal, and it had only provisions for three months. There were, too, terrible rumours concerning the siege artillery, which was said to be on its way from Germany. Perhaps all was not so well as it seemed to be. We now know that it was not, and that a month after the Germans had eaten their Christmas dinner in the "wilderness"—to be exact, on January 30th, 1871—Pari , starving and disillusioned, capitulated.

Piccadilly Tube—Western Extension.—A contract for the construction of the first section of the extension of the Piccadilly tube from Hammersmith westward to Northfields has been entered into with Balfour, Beatty and Co., Ltd., of 66, Queen-street, E.C. 4. The works to be executed under this contract extend from Hammersmith Station to Ravenscourt Park Station. The contract involves the construction of a covered way under Hammersmith Broadway and Beadon-road, to a point almost opposite the Lyric Theatre, where the two new tracks will emerge into a cutting. Shortly after leaving the mouth of the covered way the tracks will diverge, one passing through to the north side and the other running along the south side of the existing viaduct of the Southern Railway. The tracks will rise out of the cutting on to embankments and will ultimately be carried on two viaducts, one each side of the Southern Railway viaduct, to a point just east of Ravenscourt Park Station, where they will join up with the disused tracks of the Southern Railway. The Underground Company has secured a long lease of these disused tracks between Ravenscourt Park and Turnham Green. In addition to the covered way, viaducts and earthworks described above, the work entails the construction of a new public subway and convenience at Hammersmith Broadway, and the diversions of a 4ft. by 2ft. 8in. main sewer cables, gas and water mains.

AERIAL VIEW OF PART OF THE PORT OF HALIFAX, N.S.

Port Improvements at Halifax, N.S.

Halifax, the Atlantic gateway of Canada, appears to be making a determined bid to become a great national port. The past year has witnessed notable developments both in the increased volume of business and in the enlarged facilities for the flow of rail and seaborne traffic. The Harbour Board is at the present time sponsoring one of the most ambitious programmes of development ever undertaken at the port. An immediate outlay of almost a million dollars will be required to carry out plans which have been approved.

When the Harbour Board was constituted and took office in January, 1928, it was confronted, first of all, with the necessity of assembling and setting up a technical and mechanical organisation and of establishing a new system of harbour administration. There was, necessarily, delay, incidental to the transfer of the control of the various harbour properties and services from the several departments of control, in getting the work under way. Hence, while the Board has been in existence since the date mentioned, it has only been operating actively for a little more than a year. During that period, however, it has amply justified its creation. It has to its credit substantial accomplishments: (*a*) in enlarging and making more efficient the facilities and equipment of the harbour; (*b*) in greatly increasing the traffic capacity of the port; (*c*) in creating on the deep-water frontage at Richmond a new industrial section which is second only to the provision made for development of overseas shipping; and (*d*) in the establishment for the first time of a centralised harbour management with full authority and adequate resources to initiate and carry on a vigorous and well-considered programme of port development.

The port facilities are assembled in three groups—at the newer Ocean Termini, at Deepwater, and at Richmond. The bulk of the new construction work completed, under way or projected is at the Ocean Termini group, where the lines of railway and steamship services meet. There the Board is carrying out an extensive scheme of development. In addition to the existing dock and berthing accommodation, consisting of the landing quay, 2006ft. long by 400ft. wide, at which three ocean liners can be moored simultaneously and on which is the Immigration Building, which in its modern equipment and conveniences is not equalled on the continent; berths 23 and 24, more than 1250ft. long, with two sheds enclosing four railway tracks; and berths 25 and 28, on Pier A, which is 1250ft. long and 350ft. wide, with sheds and four railway tracks, the Board has erected a new brick shed of the most modern type of construction on Pier 20, which is claimed to be one of the finest ocean shipping sheds in existence. It gives the Board continuous shed accommodation along the quay wall of 2000ft. and affords facilities for the economical and expeditious handling of freight and passenger traffic.

The Board has also reconditioned the existing modern sheds by laying permanent concrete floors. It has replaced the mud roadway leading to and from the piers with a pavement of scoria blocks which extends the whole length of the Ocean Termini. There is also under construction Shed No. 27 of "A" unit of the Ocean Termini, which measures 650ft. by 90ft., as well as a track shed 43ft. wide.

The capacity of the grain elevator—which is seen in the background of the accompanying engraving—has been doubled by the extension of conveyors and galleries and the construction of a new section, at a cost of one million dollars. This extension provides the Board with ample accommodation for the storage and loading of the increasing flow of grain from the Prairie Provinces to the Atlantic seaboard for transshipment to Europe. A contract has also been entered into for the construction of "B" unit of the Ocean Termini plan. This new pier, which will be directly to the south of Pier "A," will be 1200ft. long and 260ft. wide. It will contain four berths for the largest ocean liners, with four transit sheds. The Board has also erected an office and administration building, at the extreme north of the quay wall, in which all the business and the activities of the Board will be centred.

An essential feature of terminal equipment is cold storage accommodation, which has been provided in the extensive plant of the Nova Scotia Public Cold Storage Terminals, Ltd., for which the Harbour Board allotted a site on the water front in close conjunction with railway and ocean freight facilities. This plant—seen in the centre of our engraving—cost 2,500,000 dollars, and though it was designed and equipped especially to handle meat and other similar food products of all kinds, it gives promise of being of greatest service to the Nova Scotia producers of fish, apples and potatoes, for which it has a refrigerated space of nearly 900,000 cubic feet. The operators possess the exclusive control for the Maritime Provinces and Quebec of the Birdseye process of brine freezing, which method of preserving the freshness of fish is the outcome of the experimental work of the Biological Board of Canada and its Atlantic station.

Another important subsidiary industry on the Harbour Board's property at the Ocean Termini is the large coal bunkering plant of the Dominion Coal Company, which has been erected at the outer end of Pier A. With modern discharging and loading towers having a capacity of 400 tons per hour each it has equipment for speedy coaling of large ships, while just across the harbour, at the big works of the Imperial Oil Company, a supply of oil fuel is readily available for the increasing number of oil-burning steamers. There is also within easy reach a floating crane, capable of lifting 100 tons, which is operated by the Halifax Shipyards.

Farther north, at Deepwater, the Harbour Board has reconditioned Pier 2, which is 900ft. long and 250ft. wide. Being no longer required for the use of passenger liners, its immigration equipment has been dismantled and it has been converted into a heated storage building for the use of the potato trade. Piers 3 and 4 have also been reconditioned and remodelled for the handling of heavy freights, all being connected with the railway by several tracks.

But the most interesting and, in a measure, the most promising, of the undertakings initiated by the Harbour Board has been the development of the quay at the extreme northern end of the harbour at Richmond, known as Pier 9. This property, which suffered at the time of the explosion a number of years ago, has been re-made and converted into a water front industrial area on the lines of continental port development. There are situated there the large new plant of the Nova Scotia Chemical Company for the manufacture of chemical fertiliser, and the recently completed plant of the Canada Cement Company, which brings its product in bulk by waterborne freight to the plant for distribution throughout the Maritime Provinces. There are also two coal companies operating at Pier 9. The enterprise of the Harbour Board in creating an industrial section at tidewater with the most advantageous shipping conditions by land and water, promises to add to the ocean business of Halifax an industrial development of no small magnitude.

Marine Exhibition in Paris.

The increasing employment of internal combustion engines on inland waterways and for the fishing fleet, and the propaganda which is being carried out to encourage popular interest in everything attaching to the navy and marine gave importance to the annual Exhibition in Paris. Since it was initiated five years ago the popularity of the Exhibition has grown, and although the covered area along the Seine embankment was not extensive, the Show was, nevertheless, representative of the lighter branches of marine engineering. It was, however, devoted almost exclusively to the requirements of owners of barges and pleasure craft, except the heavy marine engines presented by some foreign makers, and so far as concerns one of the most extensive applications, future business is closely linked up with the methods that are to be adopted for navigation on the inland waterways. The northern canals are being electrified, and that does not altogether satisfy the navigation companies, which fear that they will suffer from the effects of a monopoly, while on the Seine it is becoming more and more the practice to run barges under their own power. In view of the competition with the railways, costs have to be reduced to a minimum, and experience has shown that there is nothing cheaper than the heavy-oil engine. Self-propelled barges of 600 tons and more deal with the traffic more expeditiously and more conveniently than a line of barges in the wake of a tug. This opens up a field for heavy-oil engines of foreign construction. The French have made less headway in this branch of engineering than some other countries, and the foreign participation in the Paris Show provided ample evidence that foreign manufacturers are doing a large share of the trade.

There were few French engines of the solid fuel injection type. Renault exhibited their two and four-cylinder marine engines of 30 H.P. and 60 H.P. respectively, running at 750 revolutions per minute and equipped with reduction gear, if required. Peugeot showed their Junkers engines, which are manufactured in France under licence, and the Société Générale de Constructions Electriques et Mécaniques (Alsthom) has secured a good position

on the market with Thomson engines of the two-cycle type, with vertical injection above the piston and with relatively low compression. The heavy-oil engine has not yet become a prominent feature of the lighter branches of French marine engineering, and some firms still effect a compromise, such as the Ateliers et Chantiers de la Loire, whose engines, of the usual four-cycle pattern, run on an equal mixture of petrol and gas oil. Many attempts have been made to adapt heavy oil vaporising devices to petrol engines, and, in the Altos system, the gas oil impinges by suction from an injector on to a hot plate raised to a temperature of 300 deg. Cent. by the exhaust, and the oil vapour is then mixed with the incoming cold air. Few firms have been able to break away from the automobile type of engine. Hispano-Suiza, Lorraine and other makers of aero-engines continue to offer light and powerful units for high-speed craft, but they do not seem destined to do more than satisfy special requirements. The interest of the Show lay more particularly in the foreign engines, which were all specially designed for marine purposes and were invariably of the injection type. The German industry was represented by Deutz and also by the Motoren-Werke-Mannheim A.G., with four and six-cylinder engines, the latter being reversible and developing 110 H.P. at 600 revolutions per minute. The Société "Supdi" manufactures Ruston-Hornsby engines under licence and two of these built in France were shown, as well as a large marine set imported from England. It is worth remembering, as a point in favour of British industry abroad, that the Hornsby crude oil engine has a longer history in France than any other, and the manufacture of Ruston-Hornsby engines in that country will do much to maintain British reputation. The Anglo-Belgian Company, of Ghent, and the makers of the Hill and Chrysler heavy-oil engines in the United States, were represented at the Show, one of these firms giving figures of sales that proved the importance of the business done in France in solid fuel injection engines.

For the conversion of small boats into motor-propelled craft a convenient method is to pivot, in place of the rudder, a tube with a propeller shaft driven by a small engine at its upper extremity, the mobile propeller serving as a rudder. Both French and American makers are doing a considerable business in these small outboard equipments. The system has been developed for larger boats and is generally in the form of a unit bolted to the stern of the boat and extending outwards with a vertical tube for the propeller shaft. An example of this type of propelling mechanism was exhibited by the Société S.O.P.U.A., in which the bed is a ribbed casting bolted to the stern. It carries a four-cylinder engine of 12 H.P. and the transmission to the vertical propeller shaft is by bevel wheels, and at the bottom of the tube motion is given by bevel wheels to a short horizontal shaft carrying the propeller. This shaft is in a casing rotated by a steering wheel through a pinion and spur wheel. In the smaller sizes the whole unit is pivoted at the rear to allow of the propeller being raised, while in the larger sets the end of the bed carrying the propeller shaft tube is alone pivoted. The system is similar to that adopted in Belgium for barges, and various devices are employed for raising and lowering the propeller according to the draught. The advantage of the system is that it can be fitted to any barge or boat without encroaching on useful space or of passing the propeller shaft through the stern. It is true that the horizontal thrust is taken on the lower end of the vertical tube. This is attenuated in some of the bigger sets by giving an inclination to the propeller shaft tube.

In most of the marine engines there is a tendency towards uniformity of reversing gears. In the designing of such gears much has been done, and there is no end to the number of reversing gears that have failed to become a commercial success. Yet there is little that is left even of proved inventions, and the epicyclic gear is now practically alone, simply because of its cost. There are still a few reversing gears with sliding pinions, especially on powerful engines of the aero type, but they involve difficulties of rapid reversal that are not always easy to overcome. The epicyclic gears are cheap because they are specialised by certain firms. There is a French firm which turns out nothing but small reversing gears of this type, and at the Show it was noted that most of the larger reversing gears came from Holland. For the same reason the compressors on many of the engines were manufactured in Switzerland. This specialising to bring down prices is particularly necessary in the assembling of marine power sets for ordinary users.

Further interest was given to the Show by the participation of the French Marine and by the instructive documents presented by the Association des Grands Ports Français, while along the embankment were all kinds of pleasure craft, the construction of which is an important industry at Sartrouville and other suburban towns on the Seine. As a means of stimulating public interest in maritime matters and encouraging private navigation on an exceptionally large system of inland waterways, and thereby opening up a market for marine engines, the Show, which opened at the end of September and closes at the end of this week, appears to have met with some success.

Congress for Concrete and Reinforced Concrete at Liége.

(By A British Delegate.)

The official opening of the First International Congress for Concrete and Reinforced Concrete took place at Liége on Monday, September 1st, 1930, at 10 a.m., in the Large Hall of the Northern Section of the Exhibition, under the Presidency of M. Heymon, Minister of Works and Industry. This gathering of some 600 people included representatives of 20 nations. Speeches of welcome were made by the Minister of Works and Industry, and the President of the Reception Committee, and were suitably replied to by the chiefs of six foreign delegations.

The meeting was then adjourned until 2.30 on the same afternoon, when the first technical meetings took place, all of them being held at the Liége University, in the Place du Vingt Août.

The technical meetings were dealt with in two sections, which sat simultaneously, and each section was classified into four "questions," as follows:—

Section I.

(1) Hooped concrete;
(2) Theoretical and practical study of reinforced concrete, particularly large slabs, roofs and domes;
(3) Large structures of concrete and reinforced concrete, and
(4) Contraction and thermal variations in buildings of concrete and reinforced concrete and adequate provisions against these variations.

Section II.

(5) Architecture of concrete and reinforced concrete;
(6) The composition, mixing and methods of concrete and reinforced concrete on the site and in the control of same;
(7) Moulded concrete (pipes, sleepers, posts, &c.);
(8) The use of concrete and reinforced concrete in the Colonies.

The members of the Congress were presented with a general survey of all the papers submitted under the various questions, which had been prepared by one of the members of the Committee.

The first meetings were held on the Monday afternoon at 2.30, and most of the British delegation attended Section I., for which the chairmen were MM. Danusso (Italy), Bakker (Holland), and Farid Boulad Bey (Egypt). Thirteen papers under question (2) were discussed, including one on "Stresses in Dams," by Mr. S. D. Carothers, A.R.C.S., A.M. Inst. C.E., of the Civil Engineer's Department of the Admiralty. Mr. Carothers explained the principal features of his paper, which consists of a mathematical analysis of the problem. Other speakers at this session were Professor Mesnager, of Paris; Professor Baes, of Brussels, and Professor Campus, of Liége.

The papers considered in Section I. included one by Professor Beresford Pite, on the "Architecture of Concrete," and one by Mr. Kirkwood Dodds, on "Reinforced Concrete in Great Britain," and four papers upon "Colonial Uses of Concrete."

In the second technical session held on Tuesday afternoon, September 2nd, the first paper considered was one by Herr J. Blazek, of Prague, dealing with "Structural Tests on Models by Begg's Method," which paper was explained in a very interesting manner by the aid of a film. Another paper which provided an interesting discussion was one by Dr. Wyss, of Zurich, on "Experiments on Anchoring Hooks at the Ends of Reinforcing Bars for Concrete." This paper gives tests results which indicate that cold bending of hooks is attended with danger of cracking under certain conditions and should be studied carefully by reinforced concrete designers. Professor Ros and Dr. Eichinger, of Zurich, presented, at this session, their paper upon "Results of Measurements of Deformation and Tensions of Mushroom Floor Slabs," which gives the results of actual measurements made upon a building with mushroom slab floors and compares the results with those of known methods of calculation. It is a very useful and interesting paper, and British readers are helped by the fact that the notes on the many diagrams are in English, French and German.

Mr. Ewart S. Andrews illustrated his paper upon "A Study of Plain and Reinforced Concrete Retaining Walls" by lantern slides of the diagrams, and appeared to make the principal points of his paper understood by most of the audience. The session proved most interesting.

Meanwhile, the other section considered eleven papers, which had been contributed under question (7), including a very good one on "Piles," by Mr. J. McCarthy, M.I. Struct. E., A.M. Inst. C.E.

In the third session, held on the morning of September 3rd, there was so much of interest in both sections that the British contingent had some difficulty in deciding upon which to attend. In the second section a number of papers on the subject of the proportioning of concrete was considered. Many of the papers were by Belgian engineers, who, clearly, have given considerable attention to the subject, and another important paper was given by Dr. Hummel, of Berlin. This session was over comparatively early, so that members were enabled to proceed to Section I., where they found Mr. Harry Jackson holding the fort in a lucid discussion of Dr. Oscar Faber's paper upon "Temperature and Cement." Dr. Stradling, the Director of the British Building Research Station, was one of the chairmen at this meeting, and other papers of particular interest to British members were one by Mr. C. S. Gray, B.Sc., A.M.I. Struct. E., on "The Effect of Temperature on Flat Arches Constructed of Reinforced Concrete," and one by Dr. W. H. Glanville upon "Work of the Building Research Station on Small Movements in Concrete." We understood that an important contribution to the discussion in this Section was given by Monsieur Freyssinet, the engineer responsible for the great reinforced concrete bridge near Brest. A film dealing with that bridge was shown later, but, unfortunately, most of the British Section missed seeing it, owing to their not having followed the announcement, made in rapid French, relating to it.

In the afternoon session most of the British section attended Section II. in support of Mr. C. S. Jackaman, M.I. Struct. E., who explained his paper upon "Some Notes on the Composition, Mixing and Application of Concrete in Engineering Works," and of Major T. R. Grigson, who dealt with salient points in his paper on "The Composition, Mixing, Methods of Application of Concrete and Reinforced Concrete as Used in the Yards and the Control of the Same." Quite an animated discussion followed, a noteworthy feature of which was that a Dutch engineer, a Swedish engineer—Mr. Frost, of the Swedish Government testing station—and a Belgian professor (Professor A. Magnel), spoke in excellent English. Professor Magnel replied in splendid style to trenchant remarks made by Mr. Harry Jackson in support of Mr. Jackaman and Major Grigson's views of fluidity of mix, in the light of remarks made by Professor Magnel in his general review of all the papers.

A Danish engineer, Mr. E. V. Meyer, in explaining his paper on cellular concrete, also spoke in English. In fact, he performed the excellent feat of repeating his remarks in German, English and French.

Meanwhile, Section I. had been discussing some interesting papers under question (3), including important contributions by Mr. M. Gerard, M.I. Struct. E., Monsieur Freyssinnet, and Dr. Emperger, of Vienna—one of the first honorary members of the Institution of Structural Engineers.

The final technical sessions were held on the afternoon of September 4th. In Section I., the papers discussed were several, dealing with actual reinforced concrete bridges, including one by Mr. Fishburn (U.S.A.), on "Test Measurements on the Arlington Memorial Bridge at Washington, D.C.," and one by Monsieur Lanos, entitled "Notes on the Tests made on the Reinforced Concrete Bridge in Rue la Fazette in Paris." Section II. dealt with a series of papers contributed by the Italian members of the Congress.

The general impression left upon the British members was that the papers and discussions were of very high order, and that the Congress was, technically, as well as socially, a great success, in spite of the language difficulty. Professor Mangel, of Liége, was of great assistance to the British members by the excellent English into which he translated the salient points of some of the speeches made in French.

In addition to the technical side of the Congress there was also a highly developed and enjoyable social atmosphere. A reception committee, composed of prominent Belgian engineers and public officials, had arranged a programme of entertainment as varied as it was hospitable. Beginning with a reception at the Institute of Engineers at Liége on Sunday evening, August 31st, every day, in addition to the technical meetings, brought some new diversion or entertainment either for the delegates as a body or for their ladies.

On the Monday evening, a reception at the Salle des Fêtes in the Northern Section of the Exhibition was attended by all the members, who much appreciated the warm welcome extended to them and the excellent concert provided under Monsieur L. Charlier, Professor of the Royal Conservatoire of Liége.

On Tuesday morning, the engineering members visited the works of the Société Anonyme d' Ougrée Marihaye, a large steel works and rolling mill. A halt was made on the way to see the Renory Viaduct across the river Meuse. This bridge, which carries a railway diversion around Liége, consists of twelve three-hinged arches of mass concrete with a span of 61·4 m.—just over 200ft. The visitors then proceeded to the works at Ougrée and were conducted, in small parties, to view the coal and ore-handling plant, a fine installation dealing with 250 tons of coal and 225 tons of ore per hour with a force of about seven men.

The buildings and structure of this plant are entirely of reinforced concrete, the slag cement used being produced in the works itself, while slag was also used for aggregate. The party then proceeded to inspect coke ovens, blast-furnaces, and by-products works. The large gas engines running on coke-oven and blast-furnace gas were much admired.

By that time everyone was quite ready for, and enjoyed, the cold buffet luncheon provided by the works. After luncheon the rolling mills were inspected, the sleeper producing plant exciting much interest. While the Ougrée works were beng inspected, the ladies of the party visited the Grotto of Remouchamps, travelling thither in motor coaches through the charming hill country of the Ardennes. The beauties of the cavern which is similar in character to, but is larger than, those at Cheddar, made a great impression. After luncheon in Remouchamps, the return journey was made by way of Spa. In the evening, a motor drive round the town gave a view of its beauties and of Fort Loncin, the scene of the heroic effort in 1914 of General Leman to stem the German invasion.

On Wednesday morning, the ladies made a tour of the Southern Section of the Exhibition, and in the afternoon made an excursion into the country and were entertained to tea by Monsieur and Madame Baar at the Château of Stovenbosch. The remainder of Monsieur Baar's wonderful collection of ancient and modern glass was inspected, a portion of it having already been seen at the Exhibition.

On Wednesday evening, at 7 p.m., Lieut.-Colonel Moncrieff, C.B.E., President of the Institution of Structural Engineers, entertained at dinner at the Hotel de Suede, the principal members of the Belgian Committee of reception and organisation and their ladies, and the members of the Institution attending the Congress and their ladies. After an excellent dinner at an enormous round table, which easily seated the whole party, a few speeches, all of them models of brevity and aptness, expressed the pleasure of the visitors at their welcome in Belgium and their wishes for an even closer friendship between the two countries. The whole party then proceeded to the Hotel de Ville to attend a reception given by the Burgomaster, Monsieur Xavier Menjean and the Echevins of the town of Liége in honour of the delegations attending the Congress. The British delegation was introduced by Monsieur Paul Fréderix. After refreshments and a concert, dancing continued until midnight.

On Thursday afternoon, by the kind invitation of Monsieur and Madame Jacques van Hoegarden, the house and grounds of the Château de Modave were thrown open to the delegates. This Château, after being for four centuries the home of the Lords of Mordave, passed into the hands of the family of Marchin in 1642. In 1658, Charles II. conferred the honour of the Order of the Garter on Jean Gaspard Marchin, and the attributes and devices of this order still appear on the furniture and appointments of the building. In 1730, the property passed by marriage into the family of the Dukes of Montmorency, and after the revolution in France, it was sold, passing eventually into the possession of Monsieur Raymond Braconier, who, later, disposed of it to Monsieur van Hoegarden. The house itself is of great beatuy and of great historical interest. The magnificent high-relief plaster ceilings of the hall and dining-room—the first showing the genealogy and arms of the Counts of Marchin, and the second depicting the labours of Hercules—were the subject of much interest and admiration, as also was the furniture in the Dukes Chamber. After tea on the lawn, a brief speech was made by Major Maitland, thanking the host and hostess on behalf of the whole Congress. This excursion was particularly interesting, as the Château is not generally accessible to the public.

The return to Liége was made *vâ* Huy, down the valley

of the Meuse, and the industrial development of this part of Belgium was seen to great advantage. The continuous series of cement works, brick factories, rolling mills, &c., culminating in the highly concentrated industrial area of Liége, which is surrounded by collieries and vast engineering establishments of every kind, made a great impression.

The day finished with a reception by the Frankignoul Pile Company, and a concert, followed by dancing.

On Friday morning, at 9 a.m., the whole delegatiou embarked on river steamers to visit the works of John Cockerill and Co., at Seraing. These works were founded in 1807 by an Englishmen, William Cockerill, a working mechanic who left England with his family seeking to improve his fortunes abroad. He offered, to the cloth spinners of Verviers, carding machines of his own invention. Success followed his efforts, and he associated his sons with him in the business. John Cockerill, when aged eighteen, took charge of the technical side of the work. In 1813, when William Cockerill retired, the concerns which he left to his sons already employed two thousand workpeople.

In 1817, John Cockerill bought from the King of Holland for 45,000f. the Château of Seraing, formerly a residence of the princely bishops of Liége. It now forms the principal offices of the company. In 1824, Cockerill erected a blast-furnace using coke, and the employment of powerful steam-blowing engines gave an ease and abundance of production which initiated a revolutiôn in the making of cast iron, and Cockerill became the forerunner of new methods of iron working on the Continent. Later, in 1835, the first locomotive engine and the first rails produced on the European Continent, were turned out at this works. After Cockerill's death in 1842, the works were taken over by a company which introduced the Bessemer steel process to the Continent and started its converters in 1863. Subsequent developments included the use of blast-furnace gas for power-producing plants. In 1895 an eight-horse gas engine was run on that fuel. To-day, in 1930, the visitors saw 10,000 H.P. machines in use in the works and many others at Ougrée. Such is the history in brief of the works visited by the delegates.

Welcomed at the office by the directors, the party passed through machine shops, boiler shops, bridge yards, structural steel yards, heavy press shops, foundries and blast-furnaces, steel work and rolling mills. Some of the visitors also inspected the cement works. The whole concern employs some 10,000 people.

After an excellent luncheon given by Messrs. Cockerill, the delegation re-embarked and visited, at the Ile Monsin, the barrage, a flood regulation work of great magnitude designed to prevent a repetition of the catastrophe of January 1st, 1926, when the water rose in the streets of Liége to a height of several metres. This work, combined with a large dock system, will make Liége an inland port of the first order.

In the evening, after the technical meetings of the afternoon, the proceedings of the Congress were completed by a banquet in the Salles des Fêtes, Southern Section. The after-dinner speakers expressed their thanks to Belgium for their entertainment and their beliefs that engineers would, by their activities, promote that world friendship and peace so necessary at the present time.

It remains to express our deep appreciation of all the kindness so lavishly bestowed on us and to offer our thanks to the Committee of Reception, especially to Monsieur Paul Fréderix, Monsieur and Madame Baar, Monsieur and Madame Jacques van Hoegarden, Monsieur and Madame François, Monsieur and Madame Baes, and Monsieur and Madame Grenier. We truly felt that, in Liége, to be British was to be welcomed and to be amongst friends. It is the hope of all of us that in the future, in similar circumstances, the Institution of Structural Engineers will be able to show its gratitude by returning in like manner the hospitality it received.

MANCHESTER ASSOCIATION OF ENGINEERS.

A very instructive visit was paid by members of the Manchester Association of Engineers on Saturday last to the Trafford Park Works of the British Oxygen Company, Ltd. Those who were interested in the chemical side of the firm's activities found food for thought in the methods and plant employed in the manufacture of oxygen from the atmosphere, as well as in the means adopted for its compression and liquefaction. Much of the extensive plant for these purposes is of the firm's own design and construction—the outcome of over forty years' experience—based largely on Brinn's original patents. Mechanically, the process of oxygen manufacture is particularly interesting on account of the difficulties which have had to be overcome to obtain the gas sufficiently pure and to compress it to the pressure of 1800 lb. per square inch for charging the cylinders in which it is sold. The compression is accomplished in three stages, and as the presence of oil in the compressors would be a source of danger, the problem of lubrication has been fraught with extreme difficulty. In addition to the above-mentioned processes, the visitors were shown some of the British Oxygen Company's latest appliances for cutting and welding metals and for hardening gear wheels. The last-named operation appealed with special force to those members who have to deal with the construction of power transmission mechanism, because it is claimed that the Shorter process enables the teeth to be hardened on the wearing surfaces only with the minimum of distortion. The machine on which the work is carried out obviates the use of heating furnaces, the hardening being effected by the use of an oxy-acetylene blow-pipe with water as the quenching medium. In this process the gear wheel, of carbon steel, is mounted on a spindle in a tank of water, the blow-pipe is carried on a movable carriage with the necessary water pipes, so that the whole is traversed across the surface of the teeth individually, bringing it to the critical temperature and quenching it without affecting the root and core of the tooth. In this manner distortion of the wheel is obviated almost entirely while the depth of hardness is greatest at the pitch line. The members who were specially interested in welding were shown the application of fusion welding by the oxy-acetylene flame to metals of all kinds, similar and dissimilar.

At the conclusion of the inspection of the works, the visitors were given tea by the company, and Mr. H. M. Devereux, the manager, gave a short address in which he outlined the origin and development of the British Oxygen Company, which, he said, was responsible for the first oxygen plants installed in Germany and America. Mr. G. E. Windeler, president of the Association, acknowledged the indebtedness of the members to the company for permission to view the works and for its hospitality.

Industrial Conditions.*

By Col. Sir JAMES LITHGOW.

Last season I ventured to draw your attention to some aspects of the organisation of industry in Scotland in the hope that you might be stimulated to helpful endeavour for the benefit of our trade and of our country.

Events of the past year have very strongly emphasised that there is something far wrong with British trade, since we are failing to give employment to a substantial section of our working population, who are thus becoming a national liability rather than an asset.

Although many have believed—I think wrongly—that our troubles of the past few years were due to world-wide causes, it is perfectly true that we are now in the midst of a world industrial depression, which makes it inevitable that business should be restricted and orders available only at the lowest possible costs. I, therefore, observe with the utmost alarm that during the past twelve months, when world stringency was staring all of us in the face, those in control of many of the services, which are ultimately largely maintained by your industry, have actually substantially improved their conditions, conditions which were already the envy of those in the primary trades. Such a paradoxical position may bring cheap popularity to the committee man, or to the employer who can pass the burden on to you. It must, however, forcibly bring home to you that those who are loudest in their protestations that there should be equality of opportunity and service have failed to grasp the elementary conditions which make such equality possible.

This country depends for its very existence on its export trade. It is manifestly unfair, and in the long run impracticable, that our ancillary—I might almost call them parasitical—services, whether under the control of public authorities or private bodies, should endeavour to provide themselves with a higher standard of remuneration and comfort than can be obtained by those of you who are actually doing the world's work in providing goods required in all parts of the globe for the development of civilisation. The sheltered trades, in achieving a position of superiority, have failed to appreciate their debt to the rest of the community and their dependence upon it. We can be pardoned if we suspect them not only of ignorance, but also of cynical indifference. Such an attitude forms a depressing basis for the united effort which is required of all to bring prosperity to us again, and places a heavy responsibility upon the leaders of men and of public opinion who are directly concerned.

Only those who are blinded by prejudice or are incapable of logical thought can have failed to realise in the last few months that make-shift efforts to support our people which are appropriate for temporary periods of depression cannot avail us now. Such methods have been the staple of our industrial policy for many years past. They were adopted in the belief that we were passing through a time of temporary depression. They have been amplified by each succeeding Government, with the approval of public opinion, with no more definite idea of ultimate result than a hope that something would turn up. Can anyone to-day doubt that such a policy has been definitely wrong in respect that the depression which we were attempting to combat was not a temporary world-wide depression which could be safely disregarded by those not directly concerned? On the contrary, depression has endured in this country side by side with vigorous activity in almost every other country in the world. We would, therefore, be wise to recognise that our diagnosis of the trouble having been inaccurate, our remedies have been equally inappropriate, and, therefore, harmful.

I have no hesitation in saying that unless those who exercise power over our public policy quickly realise this fundamental fact, the most gloomy forebodings for the future of our country will be justified.

I am, however, still full of confidence that our people will not be wanting in this time of crisis, if only those to whom they look for leading will themselves recognise and proclaim the facts. It is because I believe that a body of men such as the members of our Institution can play a most useful part in this direction at such a time that I have ventured to refer to these questions again to-night.

Engineers and shipbuilders are accustomed to deal with problems affecting physical forces. Their technical skill enables them to reduce these forces to accurate measurement, and to apply the necessary energy in the required way to overcome these forces and produce the required results. The forces governing human affairs are not so easily measured, nor controlled, nor put in motion, but the same fundamental laws must be observed if any required result is to be obtained. Even a sailing ship cannot reach her destination by merely lying in harbour waiting for a breeze. An industrial country cannot enjoy a high standard of life if it does not make the necessary effort.

It, therefore, appears to me to be appropriate to ask the members of the Institution this question: Whether and to what extent is it possible for the engineering and shipbuilding trades in Britain to maintain those engaged upon them in a higher degree of comfort than those same trades maintain in other European countries? I ask this question because there is no shadow of doubt that we are attempting to maintain for our people more comfort than obtains in other European countries, and unless this attempt is based on some sound foundation, it cannot possibly prevail with any hope of permanency.

That we are already failing in our endeavour is surely manifest from the fact that we have failed to participate, even to a modified extent, in the industrial activity which, in recent years at one time or another, has been enjoyed by every one of our competitors. It is also beyond question that in the present depression our employment position is not only actually, but relatively, very bad indeed.

Assuming, as I believe we must assume, that we now enjoy no inherent natural advantages, a favourable answer to our question can only depend on the aggregate effort of all sections of the community. It must depend upon the extent to which each is prepared to do his or her own part in a spirit of cheerful co-operative endeavour.

It appears to me that these considerations reveal not only the defects in our present scheme of things, but the direction in which they may best be rectified. Speaking broadly, one of the most disturbing features of our post-war life has been the extent to which each section has relied upon the other for providing that higher standard which it is easy to covet, but not so easy to earn. Clamour has arisen from all sides that the Government or the Local Authority ought to do this or that for one class or for another, or even for industry itself. Those responsible for the conduct of Government or Local Authority have been ceaseless in their demands that industry should reorganise, and that capitalists should provide them with the wherewithal to meet the growing popular demands for services which in earlier times were provided by the individual.

These conditions are said to arise from physical and mental reaction following the war, but here again the conditions will not pass away of their own accord, but must be combated by all those who have the will and the power to see things as they are and as they should be.

I venture to suggest to you that we can only maintain a higher standard of comfort than obtains in competitive countries to the extent to which, by greater effort, by better organisation, and by the support of all sections of the community, we can justify such a position. At a time like the present it is the duty of every practical man to consider such matters, to look facts in the face, and to see to it that for his part, at least, no policy of waiting for something to turn up takes the place of that active endeavour which should be the pride of every craftsman or brain worker.

The particular direction in which this Institution, as an Institution, appears to me to be able to help in such a solution is the extent to which it can apply itself to the development and co-ordination of discussion and research on the technical and managerial problems with which it takes cognisance.

* Institution of Engineers and Shipbuilders in Scotland (Incorporated). Presidential address, October 7th.

TAR AND THE ROADS.

In the Report of the Highway and Sewerage Committee, City of Sheffield Engineer and Surveyor's Department, for the year ended March 31st, 1930, the following passages occur:—

"In view of the controversy as to the relative merits of tar and bitumen for roadmaking and maintenance, it may be well to state briefly the position in Sheffield.

"There seems to be an impression that because large quantities of bitumen have been employed, the use of tar has been discontinued. This is not the case. There has been no decrease in the use of tar. What has happened is that during the last ten years the mileage of tar and bitumen roads has steadily increased, and bitumen, a comparatively new material so far as roadmaking is concerned, has also been used in large quantities.

"Both materials have their uses and every effort is made to utilise the home-produced material.

"At present an important development is taking place. The Yorkshire tar distillers have offered for trial a number of specially prepared and blended tars. These special tars have been applied on about forty trial lengths, covering more than 8 miles, of important roads, some carrying as much as 7000 tons per day, under varying conditions. The tests are being carefully observed and are already providing interesting comparisons, upon which a further report will be made. At the moment it may be said that so far as can be judged after the summer's experience, some of these special tars are much superior to the ordinary standards. Many of the trial pieces which have been subject to heavy traffic present an excellent surface, which from the point of view of safety also leaves nothing to be desired."

Busk Studentship in Aeronautics.—The Trustees of this studentship, founded in memory of Edward Teshmaker Busk, who lost his life in 1914 whilst flying an experimental aeroplane, have awarded the studentship for the year 1930–31 to Mr. Robert Hugh Francis, B.Sc., of the University College of North Wales, Bangor.

Physical and Optical Societies: Twenty-first Annual Exhibition.—The twenty-first annual Exhibition of Electrical, Optical and other Physical Apparatus is to be held by the Physical Society and the Optical Society on January 6th, 7th, and 8th, 1931, at the Imperial College of Science and Technology, South Kensington. As on previous occasions, there will be a Trade Section and a Research and Experimental Section. The Section for the work of Apprentices and Learners, introduced at the last Exhibition, is to be continued. The Trade Section will comprise the exhibits of manufacturing firms, and preliminary invitations to these exhibitors are being issued, entries being asked for by October 24th. The Research and Experimental Section will be arranged in three groups:—(*a*) Exhibits illustrating the results of recent physical research; (*b*) lecture experiments in physics; and (*c*) historical exhibits in physics.

The Institute of Transport.—The Council of the Institute of Transport has considered a proposal that next year, in place of a congress in this country, a continental tour and congress open to all classes of members of the Institute should be arranged. It is suggested that the tour should take the form of inspections of Italian transport undertakings and works and visits to certain centres of transport and cultural interest in Italy; that the party should leave London on a Saturday afternoon towards the end of May or early in June, 1931; and that the tour should occupy approximately sixteen days. The following provisional itinerary has been proposed:—London to Como, *vid* short sea service, Basle, thence by daylight travel to Lucerne, Brunnen, Altdorf, Andermatt, Goschenen—for the St. Gotthard Tunnel—Bellizona, Lugano and Chiasso; Milan; Venice; Florence; Rome; Genoa and Turin, the return to London being made *vid* Paris. Members desiring to make tentative reservations for the tour are invited at their earliest convenience to communicate with the Secretary.

Railway and Road Matters.

The directors of the railway between Bilbao and Portugalete are considering the purchase of material for electrifying the line.

The interesting fact was revealed by Mr. Morrison, when speaking at Harrogate on September 24th, that, in the City of London, where £120 per square foot has been paid for widening a street, the bare space occupied by a stationary motor coach, say, 30ft. by 10ft., might be worth £36,000.

The weekly traffic returns for the thirty-ninth week completes three-quarters of the year. They show that the decrease, compared with the first nine months of 1929, on the London, Midland and Scottish, is £3,559,000; on the London and North-Eastern, £2,376,000; on the Great Western, £1,084,000, and on the Southern, £461,000.

There have been many complaints in the Press of the inability of the public to obtain beforehand time tables in order to show the changes made in the train times when the winter services were brought into use on September 22nd. This reminds us that when a similar complaint was made some years ago the then companies gave an undertaking to the Board of Trade that ample notice should be given of the changes. We offer the suggestion that on this occasion delay was probably due to late decisions as to the closing of stations and branches against passenger traffic. It must be remembered, too, that in these later days there are only two general changes in the time tables a year—the summer service from the middle of July to the third week in September, and the winter and spring service which covers the rest of the year.

The Municipal Tramway and Transport Association has just had its annual meeting, under the presidency of Mr. Thomas Canby, a member of the Huddersfield Corporation. According to *The Times*, Mr. Canby said that the advent of the internal combustion engine opened up such a startling era that within a single decade it had challenged the position of the British railway companies as passenger transporters. Those companies with a capital exceeding £1,200,000,000 stood face to face in 1928 with a progressive competition of an increasingly menacing character. The Road Traffic Act committed a most beneficent massacre in the history of local government in this country. It repealed out of hand the powers of 1345 authorities which had licensing powers, and, what was most remarkable of all, without a protest by the victims.

The Montreal Locomotive Works has turned out the fastest steam driven engine in Canada, known as the "Hudson Locomotive 5700," for the Canadian National Railways. It is the first of five, the remainder to be delivered within a month, and it will be employed to haul the International Limited train of the system from Montreal to Chicago. It has a possible speed of 80 miles per hour, and its driven wheels are 80in. in diameter—the largest in Canada. The engine and tender weigh more than 531 tons. The water and coal capacity of the tender is greater than that of any other locomotive on the system. Twenty tons of coal and 14,000 Imperial gallons of water will be carried. The boiler pressure is 275 lb., and the maximum tractive power without the booster is 43,300 lb. With the booster another 10,000 lb. may be added.

Two more sleeping cars, to the design of Mr. H. N. Gresley, have been put into service by the London and North-Eastern to supplement the two mentioned in a note in the Seven-day Journal of our issue of August 15th last. A feature of all these cars to which we would draw attention is that there is now no occasion for an electrically-lighted sleeping car to carry gas for heating a stove wherewith the attendant boils water for tea; that is now also done by electricity. Our point can perhaps best be appreciated by relating that the "Royal Highlander," concerned in the Dinwoodie accident of October 25th, 1928, was, according to Colonel Mount's report on that collision, lighted throughout by electricity, except that the last vehicle—a van—had gas, and this information was supplemented by the remark "there was also gas for heating purposes in the two first-class sleeping cars."

The public announcement has been made that "the London and North-Eastern Railway has decided to adopt generally the electric colour light system of signalling." We think, however, that such a radical departure as the adoption "generally" of colour light signals cannot be intended. These signals could be actuated by primary batteries and need not necessarily have track circuit, but both these are the usual features in colour light signals. What strengthens our doubts as to the announcement not being quite accurate is that the only installation of any size of such signals on the London and North-Eastern was that between Marylebone and Neasden, fixed by the Great Central nearly eight years ago. They were the first of the type on any British main line and are, in many respects, out of date. What may be intended is that all large installations of signalling shall have these signals and not those of the semaphore type.

A message from Guatemala City says that following a close study of the requirements of the International System of Railways of Central America, it has been decided to adopt, as part of the lines' permanent standard equipment, gas-powered motors on the service between the Atlantic and Pacific oceans—from Puerto Barrios in Guatemala to San Salvador in El Salvador. Each motor car will have a six-cylinder, four-stroke cycle, valve-in-head, heavy duty type engine, rated at 175 H.P. at 1300 revolutions a minute. Situated at the forward end, the engine will be demountable as a unit. The drive will be from the engine to a four-speed transmission gear, suspended from the car body, and running from the front or idler axle to the drive truck. Among other difficult features of the system is a 17-mile continuous 2·4 per cent. gradient, reaching an altitude of 3000ft. Trains will consist of a motor car weighing 39,925 lb., carrying a paying load of 6900 lb. in the passenger compartment and 3000 lb. in the baggage compartment. The former, seating thirty-seven persons, will be for second-class ticket holders, and a trailer, with an observation platform, weighing together 27,460 lb., will accommodate twenty-two first-class passengers.

Notes and Memoranda.

A note in the *Journal of the Royal Society of Arts* says: "We are interested to note that the Bedford Corporation propose to provide electricity to villages by underground mains, the electrical engineer stating that it is possible to supply cheaper in this way than by the overhead wire system, which jeopardises the amenities of the countryside. If it is a fact, we trust that our electrical engineers will support the use of underground mains wherever possible."

An article in the *South African Mining and Engineering Journal* suggests the possibility of minimising accidents due to overwinding. In it it is proposed to make a loose connection between the rope and cage that would allow the cage to continue its travel against the action of gravity after the Humble hook had acted, and then to catch the cage on a ratchet. The descending cage would be checked in dashpot fashion by dropping into a closely fitting shaft some 200ft. deep.

The report for 1929 of Mr. J. M. Carey, his Majesty's Divisional Inspector of Mines, on the inspection of mines under the Coal Mines Act in the Cardiff and Forest of Dean area, has been published. Mr. Carey notes that no accidents occurred on any part of the 350 miles of roadway in his division on which steel rings are used for support, and he again expressed his gratification at the increased use of steel props at the face, there being now upwards of 100,000 of such props in use.

For several years an investigation of the wind pressure on chimneys and other cylindrical structures has been in progress at the American Bureau of Standards. The investigation showed that the wind pressure is a function of the ratio of the height of the chimney to its diameter and that a wind pressure corresponding to 20 lb. per square foot of projected area at a wind speed of 100 miles per hour is a safe value to use in designing chimneys of which the exposed height does not exceed ten times the diameter.

The May number of the *Canadian Journal of Research* contains a paper by R. W. Moffat, of the University of Manitoba, on the effect of low temperatures on the resistance of steel castings to impact. The series of experiments is concerned with castings, and shows that plain carbon steels may have a resistance to impact at −31 deg. Cent. of only from one-quarter to one-half of that at ordinary temperatures. By heat treatment this resistance is increased very considerably. The impact value falls off with increasing carbon. Vanadium or nickel or a combination of the two metals increases the resistance to impact. Castings with 2 to 3 per cent. of nickel have about the same resistance at low temperatures as those with 0·18 to 0·22 per cent. of vanadium. Normalising at 870 deg. to 900 deg. Cent. followed by reheating to 620 deg. to 700 deg. Cent. and cooling in still air is recommended.

If there is doubt concerning the presence of molybdenum in a sample, much time may be saved by making a preliminary qualitative test, as follows:—Fuse about 1 gramme of the pulverised sample with several grammes of soda ash and sodium peroxide in a nickel or iron crucible. Digest the melt in hot water, add H_2O_2, boil 10 minutes and filter. Acidify the filtrate with HCl, and boil off the CO_2. An alkali thiocyanate is then added, immediately followed by zinc. If Mo is present, a bright cherry-red colour will appear and finally fade as the reduction by zinc proceeds. H_2O_2 will destroy the colour, but when the peroxide has been reduced by nascent hydrogen the colour reappears. Iron, nitric acid, and chloric acid will produce colour which may be mistaken as an indication of molybdenum, but the reactions with zinc and H_2O_2 do not produce the same changes as when molybdenum is present. If properly carried out as described, the above procedure is a delicate and reliable test for molybdenum. The depth of colour produced will give an indication of the amount of molybdenum present.

Although several attempts have been made to account for the high speed of propagation of gaseous explosions, the detailed microscopic molecular mechanism of propagation from one layer of gas to the next has not received much attention. In the August number of the *Journal* of the American Chemical Society, Mr. B. Lewis has attempted to calculate the velocity of propagation of gaseous explosions on the basis of the theory of reaction chains. A single interaction between two molecules may generate a product which reacts with the next suitable molecule it encounters, the process continuing in like manner from layer to layer by reason of regenerated active products through a large number of steps or a chain of reaction. By means of a special hypothesis as to the division of the energy of reaction among the rather arbitrarily selected numbers of degrees of freedom of the molecules, Mr. Lewis finds that the energy on the carrier finally reaches a maximum limit which remains constant, and by equating this to $\frac{1}{2} M v^2$, where M is the mass of the carrier, the value of v, the velocity, is found. The agreement in several typical cases is good.

In some preliminary work at the American Bureau of Standards, a study has been made of the strength, ductility and soundness of steel castings, which involved many foundry variables. If the carbon content is maintained between 0·10 and 0·17 per cent., the manganese between 0·60 and 0·70 per cent., and the silicon between 0·30 and 0·40 per cent., the addition of aluminium shortly before pouring will give steel castings that are usually within the specified limits of ductility after the heat-treating operation. Variables having the greatest effect on ductility were found to be the materials used for degasification or deoxidation. None of these deoxidisers, such as ferroboron, ferrosilicon, or beryllium, proved superior to aluminium in producing soundness. Some experiments were made with mould preparations in the form of surface treatments with aluminium and powdered deoxidisers to counteract the mould moisture, but these treatments do not seem promising. Mould conditions, such as sand and moisture, are probably the important variables responsible for pin-holes. However, a sufficient quantity of deoxidiser should be in the steel at the time of pouring to deoxidise the steel from any gases evolved from the moisture of the mould.

Miscellanea.

A rich deposit of iron ore is said to have been discovered near Dundee, Natal.

The output of diamonds from the Angola fields increased by 31 per cent. last year, and further mines are now being started.

A new industry in South Africa is to be the utilisation of euphorbia latex for the production of resinous materials for addition to rubber latex to delay its hardening when vulcanised.

It is learned that, with a view to improving the Shanghai-Nanking long-distance telephone service, the Ministry of Communications is installing the latest sound-magnifying vacuum tubes along the line.

A commission has been appointed by the Government of Canada for the revision of that country's Patent and Trade Mark and Design Acts. Its recommendations will be submitted to Parliament next year.

It is suggested that the Canadian Pacific liner "Empress of Britain," with her speed of 24 knots, will be able to set Transatlantic passengers down in New York, *vid* Quebec, quicker than any existing direct steamer.

The hydro-electric power station at Ponali, in Northern Italy, which draws water from Lake Ledro under a head of 1800ft., already has installed two units of 30,000 horse-power each, and a third of 45,000 horse-power is under construction.

Examination of the photographs taken by the Royal Canadian Air Force for the Department of the Interior during 1929 shows that approximately 46,000 square miles have been photographed obliquely and 24,000 square miles vertically.

The Grand Union Canal Company is proposing a scheme whereby all traffic on its waterways should be conducted by motor-propelled barges, which would make it possible to carry perishable goods. It is said that the company is spending a million sterling on the scheme.

In compliance with a recent decision of the Nanking Reconstruction Commission, the Chinese Ministry of Railways has instructed Mr. Chow Liang-ching, technical expert, to start a survey for the site of the proposed central station at the capital, where the different railway lines—present and future—will converge.

A proposition has been made to the Ceylon Government in connection with the Norton Bridge hydro-electric development, by the Siemens-Schuckert Company, whereby that company is willing to make and supply a complete survey of the project and submit plans for a sum of £5500, to be increased by a fee of £15,000 should they not secure the contract for the erection of the plant.

The development of Tuticorin Harbour, as originally proposed, has, according to *Indian Engineering*, now been abandoned, as the Port Trust could not find the necessary money. The present policy is to make the most of the existing harbour by dredging the channel leading to the sea, but as the dredger may have to be replaced after about a year, tenders for a new one are being called for in England.

The keel has been laid at Palmers' yard, Hebburn-on-Tyne, for the new 300ft. midship section for the Anglo-American oil tanker "Saranac," sister ship of the "Cadillac," which was successfully lengthened in this way at the same yard earlier in the year. The "Saranac" will not be docked until early in the New Year after the launch of the new middle portion, and will then, it is hoped, be laid up for only about seven weeks.

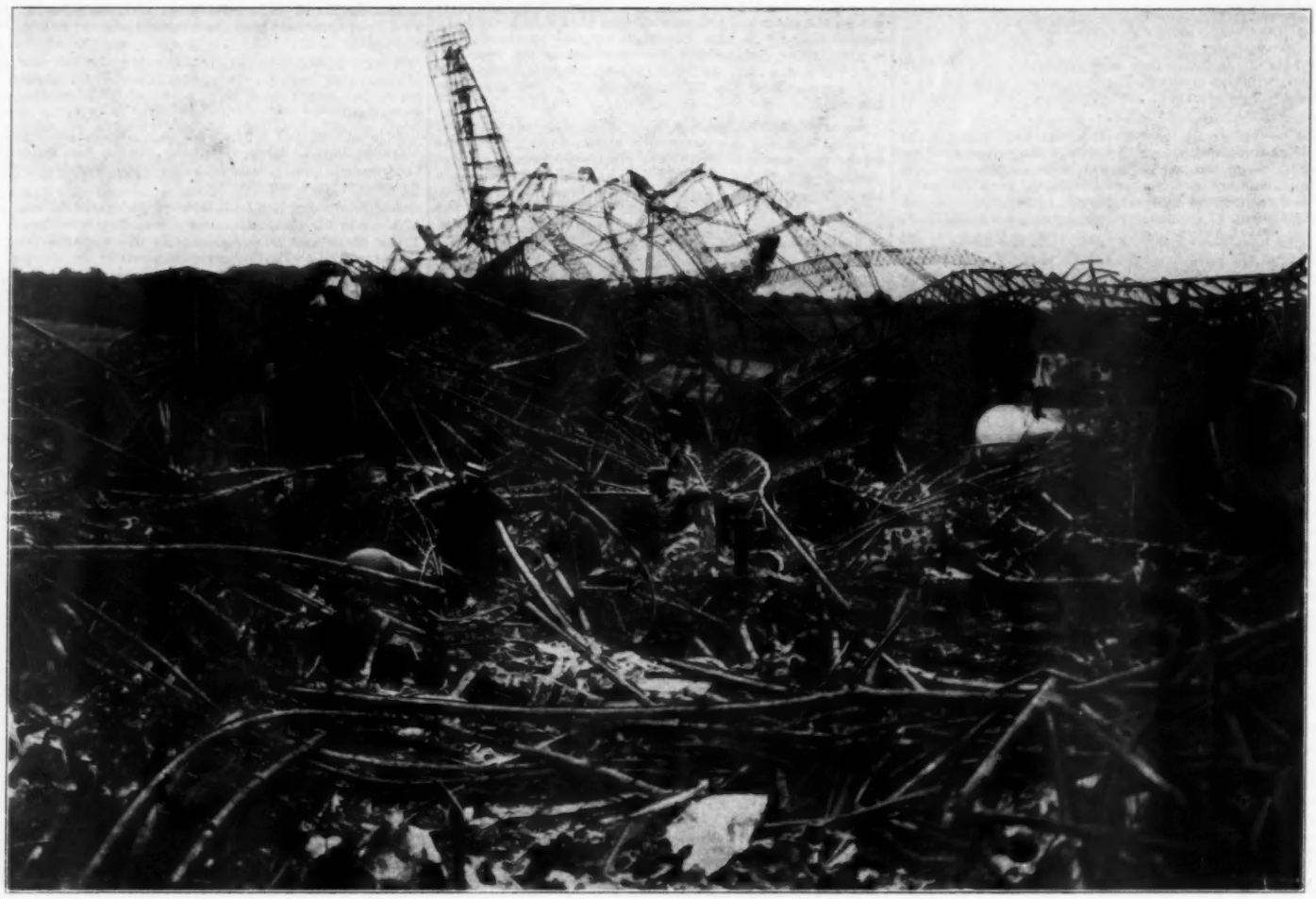
According to statistics compiled by the Kwangtung Provincial Reconstruction Department of China, a total of approximately 1000 miles (2991 li) of public highways has been completed in the entire province. In view of the fact that 577 miles of highways remain to be built before the authorised programme of provincial construction is fully realised, it is stated that special efforts will be made to complete all unfinished roads before the end of the year.

Belcher Island, off Hudson Bay, may, says the *Canadian Engineer*, be the next important ironfield, if negotiations for the exploitation of the field are completed satisfactorily in New York. The control of known deposits on Belcher Island is held by Northern Aerial Minerals Exploitation, Ltd., which is involved in a tentative deal with New York financial interests willing to undertake developments. Widespread outcroppings of iron ore are said to be evident on the Belcher and Nastapoka group of islands. Following a survey of the islands in 1916, discovery was reported of four distinct parallel bands of ore, running from 4 to 7 miles.

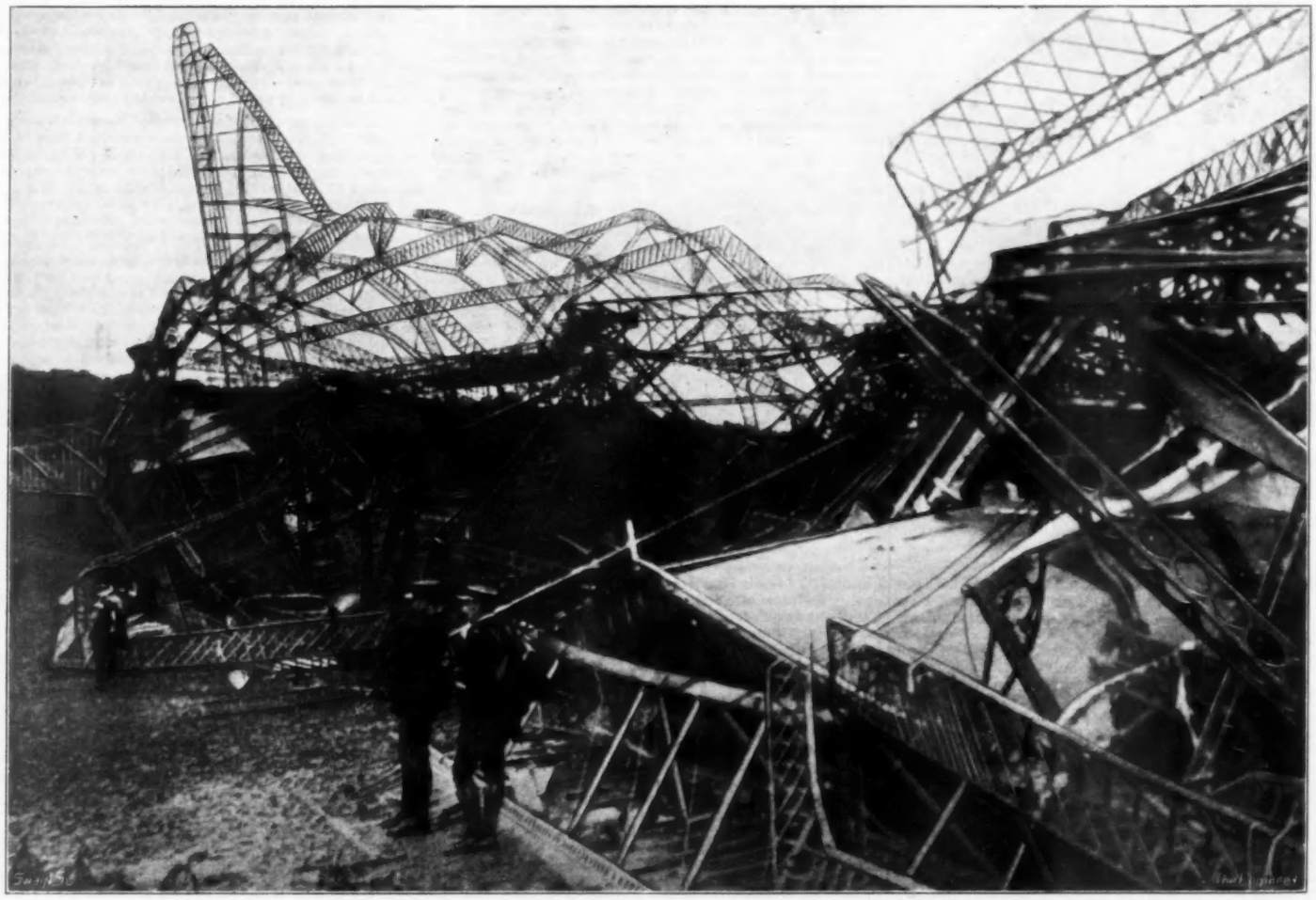
Engineers of the British Columbia Government have, says the *Canadian Engineer*, revealed tremendous possibilities for hydro-electric power production in the mountainous country from 180 to 350 miles north of Vancouver. Development in each case would necessitate turning the waters of certain lakes westward directly to the sea, and barring their natural outlets easterly to the Fraser River. Preliminary reports indicate that, in addition to the Taseko-Chilko-Homathko project, with a possible development of 1,200,000 H.P., two other positions of similar nature, bringing possible power production in the coast district up to 3,000,000 H.P., have been discovered. The two new power sites, revealed by recent surveys, are at Tahtsa Lake and Eutsuk Lake. By turning these waters westward to the sea, engineers believe that 1,800,000 H.P. can be developed. The original scheme of this nature was the proposal to divert the waters of the Chilko and Taseko lakes from the Fraser River watershed to a new outlet by the Homathko River, draining directly to Bute Inlet on the Pacific. Great storage dams and tunnels would be needed to carry the waters of these lakes, now reaching the sea by a roundabout route of 500 to 600 miles, over the proposed route of only about 50 miles to salt water. The situation of this unique scheme straddles the backbone of the coast range of mountains. Tahtsa and Eutsuk lakes are somewhat similarly situated, topographically and with respect to their natural drainage, but the new region of prospective development is some 200 miles further south.

THE AIRSHIP DISASTER

(*For description see page 395.*)



GENERAL VIEW OF THE WRECKAGE



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Contents.

THE ENGINEER, October 10th, 1930.

	PAGE
A SEVEN-DAY JOURNAL	387
RECENT DRAG LINE EXCAVATOR PRACTICE IN GERMANY. (Illus.)	388
BRITISH AND ASIATIC ENGINEERS	391
THE FUSION WELDING OF PRESSURE VESSELS	393
BONDING NEW CONCRETE TO OLD	393
ELECTRICITY SUPPLY AND FLUE GASES. (Illus.)	394
COPPER SMELTING PRACTICE	394
THE AIRSHIP DISASTER. (Illus.)	395
LETTERS TO THE EDITOR—Foreign Tongues	395
THE CANADIAN GOOD ROADS ASSOCIATION	395
SIXTY YEARS AGO	395
PORT IMPROVEMENTS AT HALIFAX, N.S. (Illus.)	396
MARINE EXHIBITION IN PARIS	396
CONGRESS FOR CONCRETE AND REINFORCED CONCRETE AT LIEGE	397
MANCHESTER ASSOCIATION OF ENGINEERS	398
INDUSTRIAL CONDITIONS	398
TAR AND THE ROADS	398
RAILWAY AND ROAD MATTERS—NOTES AND MEMORANDA—MISCELLANEA	399
LEADING ARTICLES—	
The Destruction of the " R 101 "	401
Wages and Sheltered Industries	402
OBITUARY : THE VICTIMS OF THE AIRSHIP " R 101 " DISASTER—Flight-Lieut. H. C. Irwin—Squadron Leader E. L. Johnston .. Lieut.-Com. N. G. Atherstone—Flying Officer M. H. Steff—M. A. Giblett—Lord Thomson—Sir Sefton Brancker—Lieut.-Colonel V. C. Richmond—Major G. H. Scott	403
Wing Commander R. B. B. Colmore	404
THE IRON AND STEEL INSTITUTE. No. IV. (Illus.)	404
A BROADCASTING STATION FOR POLAND. (Illus.)	406
WIRELESS INSTALLATION FOR TANKS AND ARMOURED VEHICLES	406
A NEW TYPE OF TERMINAL BUSHING FOR EXTRA HIGH TENSION. (Illus.)	407
PERMANENCE OF DIMENSIONS UNDER STRESS AT ELEVATED TEMPERATURES. (Illus.)	408
INCLINED CALANDRIA VACUUM PANS. (Illus.)	410
LAUNCHES AND TRIAL TRIPS	410
PROVINCIAL LETTERS—	
The Midlands and Staffordshire—Lancashire	411
Sheffield—North of England	412
Scotland—Wales and Adjoining Counties	413
PERSONAL AND BUSINESS ANNOUNCEMENTS	413
CONTRACTS	413
CURRENT PRICES FOR METALS AND FUELS	414
FRENCH ENGINEERING NOTES	415
BRITISH PATENT SPECIFICATIONS. (Illus.)	415
FORTHCOMING ENGAGEMENTS	416

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THE ENGINEER.

VOL. CL No. 3900

OCTOBER 10, 1930.

The Destruction of the R 101.

" HIS MAJESTY'S AIRSHIP ' R 101 ' is a huge, a courageous, and, it is certain, an expensive experiment; but, first and last and always an experiment." It is a year since we wrote these words. The melancholy task now befalls us to record that the experiment has failed. The airship lies a burnt-out wreck at Beauvais in France. Of the passengers and crew, numbering fifty-four, who left Cardington in her on Saturday evening for Karachi, all but six are dead. Excluding human error or failure, four possible broad sources of the disaster can be specified. There may have been a failure in the structure of the ship. There may have been a failure in her engine and fuel system. There may have been a failure in her navigational equipment, or there may have been no specific failure but a defect which might be described as aerodynamical unfitness, and which might have been discovered had her trials been prolonged. The accounts received from the survivors and from witnesses on the ground are incomplete and conflicting. In any event the Air Council is arranging to hold a public inquiry into the disaster. Even although we were fully informed as to its circumstances, it would therefore be undesirable at this instant to express any detailed opinion on the cause or combination of causes which produced it. Rather let us recall some of the salient facts in the technical history of the ship in order that we may prepare ourselves to follow with understanding the evidence and findings of the Court of Inquiry.

When Mr. MacDonald's Government in 1924 sanctioned a programme of airship development, involving the construction of two experimental vessels, it had in view primarily the possible use of the airship as a means of improving Empire communications. Active steps were taken at an early date to interest India and the Dominions of Canada, South Africa, Australia, and New Zealand in a scheme to provide at first an experimental, and later a regular airship service. With the exception of Canada, that scheme of necessity covered the operation of airships in tropical or semi-tropical climates. During the war, in 1917, a Zeppelin airship, the " Z 57," had flown from Bulgaria to Central Africa with supplies for the German troops operating in that region. The voyage marked the first occasion on which an airship had passed from northern to tropical latitudes, and in this respect it remains to-day the only one of its kind. It was a daring feat, justified only by the necessities of wartime. Its daring arose from the fact that the engines used petrol as fuel. It is impossible in an airship to prevent some leakage of petrol in the long lines of piping leading from the containers to the engine cars. The fuel tanks have necessarily to be distributed along the length of the hull, and cannot be concentrated near the already concentrated loads represented by the engines. Even in a cool climate the internal spaces of a petrol-driven airship soon become charged with fumes. In a hot climate the trouble would be magnified to a source of considerable danger. With these facts in view, it was decided that the two airships of the 1924 programme should be driven by heavy-oil engines. Engines of that type were not then immediately available for aeronautical use. Work was begun on their development, but various causes of delay arose, and it became apparent that if the airships were to be ready within a reasonable time heavy-oil engines could be provided for but one of them. The " R 101 " was selected to receive the engines developed by Messrs. Beardmore. The " R 100," equipped with Rolls-Royce aero-engines using petrol, was earmarked for trial on the Canadian route. The use of heavy oil engines on the " R 101 " was in its inception not so much an experiment as a necessity for the service on which she was to be employed. The actual engines fitted to her were, however, purely experimental, and round them centres the main subsequent technical history of the vessel. In the first place, as delivered they were several tons heavier in the aggregate than the estimated weight, and consequential increases in weight had to be made in portions of the ship's structure. Secondly, it was found on trial that they were subject to serious torsional oscillation in their crank shafts. Improvements were subsequently effected in this respect, but the trouble persisted to such an extent that an alteration had to be made in the designers' intentions. It had been proposed to run all five of the engines in a constant direction, and to drive the vessel astern by the use of propellers with reversible blades. The torsional oscillation was found to throw excessive stress on the blades at their union with the boss, and the idea of making them reversible had to be given up. Fixed-blade propellers were used instead, one of the five engines being equipped with a reversed pitch propeller, and being used solely for driving the vessel astern. In this condition the vessel was launched, and put through her trials. Following her appearance at the Royal Air Force display last June, she was returned to her shed at Cardington. She had by all accounts behaved satisfactorily, but the expedients which had been adopted to meet the characteristics of the engines had resulted in increasing her deadweight, and therefore decreasing her carrying capacity, and in reducing her forward driving power and therefore lowering her speed. It was determined to remedy both these defects. First as regards the deficiency of power, it was arranged to install two reversible engines in the forward cars. Engines of that pattern had in the meantime been developed, and it was therefore possible to equip the vessel with five engines, all of which would be available for forward driving, and two of which could be used for reverse running. Secondly, as regards the deficiency of lift, three principal directions were followed. The gas bags were let out a few inches all round, the original clearance between them and the framework having, so it was said, been found to have been fully liberal. Originally, a servo-motor system had been provided to facilitate the operation of the rudders and elevators. It was found quite possible to operate these organs by hand, and consequently it was decided to save weight by discarding the servo-motor equipment. Then as the major source of obtaining increased lift, the vessel was cut in two and an additional bay 50ft. in length, containing a new gas bag, was built into her structure. On October 1st she emerged from her shed in her reconstructed form, and proceeded on a trial flight of sixteen hours' duration. As enlarged, she had a length of 777ft., a gas capacity of 5½ million cubic feet, and a gross lift of 169 tons. Several minor alterations were also effected in her design, the most notable of which was that she was fitted with a system, previously tested in the " R 100," for catching the rain water which might fall on her

hull and using it as ballast to compensate for the consumption of stores and fuel. The vessel was experimental, not only in her power equipment, but in the design of her structure. What that structure was, and how it was fabricated at the works of Boulton and Paul, we have previously detailed. See THE ENGINEER, Aug. 31st, Nov. 30th and Dec. 7th, 1928. It is sufficient to say that it was composed largely of stainless and high tensile steel, instead of the usual duralumin, and was arranged in an entirely novel manner. It should be added that sections of the structure were proved by tests, and that they fully came up to expectations as regarded strength and lightness. No modifications, so far as we know, were at any time made in the structure for purely structural reasons. Unlike the engines, the structure, although experimental, contributes nothing to the technical history of the vessel. Indeed, it may be said that the structural formation adopted rendered possible, or at any rate easy, the lengthening of the hull, which was undertaken to compensate for the shortcomings of the engines.

On August 23rd, 1921, the airship "R 38" broke in the air over Hull with the loss of forty-four lives. There were many people, who, shocked by that disaster, felt strongly that it ought to be made to mark the end of airship building, so far as this country was concerned. Before the year was out, however, the Airship Stressing Panel had been appointed to study the stresses in the hulls of airships in light of the facts revealed by the disaster. Those stresses had previously been guessed at, rather than calculated. It had been discovered that a serious omission of knowledge had existed. The "R 38," it was revealed by scientific investigation, broke her back because her framework, while strong enough to support the normal aerodynamic forces, was not strong enough to take the unsuspectedly high dynamic forces thrown upon it when the vessel endeavoured to execute a sharp turn at high speed. Here was a good reason, so it was urged, for giving the airship another chance. The argument was difficult to resist, and eventually it won the day in 1924, when the Government consented to the programme of development involving the construction of "R 100" and "R 101." On September 3rd, 1925, the American airship "Shenandoah," a helium-filled vessel, broke in two in the air, with the loss of fourteen lives out of a crew of forty-two. Once again science stepped in. It was discovered that vertical currents of air of unsuspected intensity sometimes accompanied a thunderstorm. In such a current the airship had been caught, and violently tossed up several times. Her structure had not been designed to withstand any such motion, and perforce failed. The argument carried conviction and was not allowed to stop the airship activities of the country. The United States is now, in fact, building two airships, each of 6½ million cubic feet capacity. Other airship disasters have taught other lessons, but the two which we have mentioned are outstanding in the repercussion which they had on the design of "R 101." That vessel was constructed in full knowledge of the causes which had wrecked the "R 38" and the "Shenandoah." Her *early* trials proved that she was capable of executing a sharp turn at high speed. She had never encountered a serious vertical current, but there is not much possibility for doubt that, in at least her *original* condition, the allowance made for such an event was ample. In support of that statement, it may be said that the "R 100," designed to the same general strength specification, encountered and survived unhurt a severe vertical current towards the end of her outward voyage to Canada. Yet in spite of all the care, knowledge, skill, experience, and foresight which went to the making of the "R 101," the vessel has failed as suddenly, and, for the moment, as inexplicably, as any of her forerunners. Is it possible that once again scientific inquiry, wise as always after the event, will establish some hitherto unsuspected factor as the cause? Is it possible that, if it does, men will be found bold enough to urge once again that the airship should be given another chance? With a heavy heart, we are constrained to answer both questions with a "Yes." It would be against our convictions, but not against our wishes, if we answered that the disaster to "R 101" will assuredly mark the end of the airship. She was an experiment. The experiment has failed, but how near was it to success? We do not know, and may never know. It is, however, certain that when the shock of Sunday's catastrophe has become dulled by time, arguments will be advanced justifying, or attempting to justify, the continuation of the experiment. Some trifling cause, some minor error of judgment or execution, not some omission of a major scientific fact, may be the explanation of the disaster. If such proves to be the case, is it conceivable that the experiment will be permanently abandoned? We cannot believe it. We cannot hope that science, taking it and all the lamentable previous occurrences of its kind, will turn from finding an excuse for them, and instead use them to prove that the major and minor factors affecting airship construction and operation are so numerous, so complicated, and so much influenced by chance, as to leave the ambitions of their advocates outside the reach of practical realisation.

Wages and Sheltered Industries.

In his Presidential Address to the Institution of Engineers and Shipbuilders in Scotland on Tuesday last, Colonel Sir James Lithgow spoke with all that directness of purpose which those who know him would expect. It alarmed him to observe that even whilst we are in the midst of a world industrial depression "those in control of many of the services which are ultimately largely maintained by your industry, have actually substantially improved their conditions which were already the envy of those in the primary trades." Such a "paradoxical position" shows "that those who are loudest in their protestation that there should be equality of opportunity and service have failed to grasp the elementary conditions which make such equality possible." Sir James then put this question to the Institution: "Whether and to what extent is it possible for the engineering and shipbuilding trades in Britain to maintain those engaged upon them in a higher degree of comfort than those same trades maintain in other European countries? . . . I ask this question," he continued, "because there is no shadow of doubt that we are attempting to maintain for our people more comfort than obtains in other European countries, and unless this attempt is based on some sound foundation, it cannot possibly prevail with any hope of permanency."

Engineers and shipbuilders have long recognised that, by comparison with those of the sheltered industries, the wages in their trades are low. They would have raised them without reluctance had it been possible to do so. But foreign competition has placed increase quite out of the question, and we are faced with the anomaly that the men, mainly skilled, who are doing work of national importance, work which ensures us the food by which we live, have to accept a lower standard of life than those whose work often calls for no previous training and in some cases is actually redundant—preserved for the sake of giving employment. Essential as much "sheltered" work undoubtedly is, by no stretch of the imagination can it be regarded as more valuable than that performed by men in the primary industries. There is a current belief in certain circles that there is no limit to the attainable standard of living, and it is customary to accuse employers of supineness if they are unable to pay their employees at a rate high enough to secure all the comforts and pleasures of life. Instead of turning their eyes to their nearer neighbours upon the Continent of Europe, these economists fixed them upon America, and assumed without sufficient thought that what was possible there under totally different conditions was possible here. They drew their false conclusions, moreover, at a moment when the United States was basking in the sun of unequalled prosperity, and were enjoying wealth greater than any nation had known. America has now learnt that much of that wealth was visionary. Under the Wall Street crash of twelve months ago, and the succession of collapses which have followed it, the whole principle of her industrial economics has tottered. She has no longer that perfect confidence that high wages mean general prosperity and active industries, and already there is propaganda for "maintenance of the standard of living." That can mean nothing less than that the standard is already falling. This is a significant fact. If the United States, with its vast opportunities for development, its self-sufficiency in nearly all requirements, and a tariff wall which the outsider climbs with difficulty, finds itself unable under financial conditions which now more nearly resemble those of Europe than they did a few years ago to pay very high wages—if the United States with favourable predisposing conditions has to consider whether the standard of life is not unduly high, then it is doubly and trebly manifest that Great Britain cannot afford to maintain a standard which is well above that of those with whom she has to compete in all the markets of the world. The members of the Iron and Steel Institute, to take but one striking example, noticed during their recent visit to Prague that wages in the steelworks of Czechoslovakia were but half those paid in the same industries here, and that there was nothing approaching the great difference which prevails in our steelworks between the wages of skilled and unskilled workers.

Sir James Lithgow, after pointing out that engineers and shipbuilders are accustomed to deal with problems affecting physical forces, said very truly that whilst the forces governing human affairs are not so easily measured, nor controlled, nor put in motion, the same fundamental laws must be observed if any required result is to be obtained. We wish it could be recognised that not the will of man, but the pressure of economic laws settles problems such as that we have been discussing. There is a type of mind which appeals immediately to sentiment or the claims of humanity, equality, or fraternity, or what you will, if it is suggested that the industrial community should be asked to live at a lower standard than that which it at present enjoys. In the face of such people the believer in economic laws feels a hard-hearted barbarian. But there is no escaping the facts. In nearly every class of life above the lowest we are endeavouring to live on a scale which is beyond national means, and, like spendthrifts, we are hastening our own ruin. Our costs of production are too high, not because our manufacturers are less progressive than those of other nations, but because, on the one hand, they are hampered by excessive taxation which militates against rapid development, and, on the other, because, in various ways, they have to provide for their workpeople a higher standard of existence than industry can afford.

Obituary.

The Victims of the Airship R 101 Disaster.

OFFICERS.

FLIGHT LIEUTENANT H. C. IRWIN.

Flight Lieutenant H. C. Irwin, A.F.C., who was captain of the ill-fated vessel, had, during the past fifteen years, had a distinguished career as a flying officer. He was born at Dundrum, County Cork, in 1894, and received his education at St. Andrew's College, Dublin. In 1915, when he was twenty-one years of age, he joined the Airship Section of the Royal Naval Air Service as a private, and during the years 1916–17 he was captain of various non-rigid airships, including the S.S. "Zero," coastal and N.S. types, in the East Mediterranean and in home waters. At one time during the war he very nearly lost his life. "Somewhere in the Mediterranean," he had been sent with despatches, and the ship on which he was travelling was torpedoed. He went down with her, and as he sank he received a terrible blow on the head that severed nearly the whole of his scalp, which, however, was left hanging. On recovering consciousness after the effects of the blow, he found himself on the surface of the water, and was just able to swim to a boat which was picking up all the survivors it could find. A sailor, who volunteered to afford first aid, wrapped a bandage over his head, which was pouring with blood, but left the scalp outside hanging over one ear. When he reached the island where headquarters was, the doctors scarcely hoped to save his life, but they managed to do so.

In 1920 Irwin was in command of the rigid airships "R 33" and "R 36," and from 1921 to 1924 he was engaged on R.A.F. duties at various service stations on staff duties at the Air Ministry. In 1925 he was appointed to the Royal Airship Works at Cardington, and in the following year he was detailed to command, for a second time, the airship "R 33" when that vessel was engaged in practice flights designed to acquire technical information needed for the design of the airships "R 100" and "R 101." From 1926 to 1928 he was in charge of the Royal Air Force School of Balloon Training, and, in the following year, he was sent again to Cardington to take over the command of "R 101."

SQUADRON-LEADER E. L. JOHNSTON.

Squadron-Leader E. L. Johnston, A.F.C., O.B.E., Reserve of Air Force Officers, the navigator of the vessel, was born in Sunderland in 1891. He was educated at the High School at Tynemouth, and then went to the Marine School at South Shields. Subsequently, he became a qualified Master Mariner, and was for some time in the Royal Naval Reserve. In 1916 he joined the Airship Section of the Royal Naval Air Service and was in command of airships of the coastal type. Later, he was given charge of the Luce Bay airship station in the South-West of Scotland. When the R.A.F. was constituted he was given the

rank of Captain, and was, afterwards, promoted Major.

After the Armistice he was engaged for some time in the Navigation Branch of the Air Ministry, and on retiring from the R.A.F. he went to the Cardington Works to perform navigational works. While so engaged, he was lent, for a period, to Imperial Airways, Ltd., in order that he might plan aeroplane routes on the Continent. Later, he was chosen as navigator of the aeroplane which conveyed the Secretary of State to India and back.

Besides being navigator of the "R 101," Squadron-Leader Johnston was also navigator of the "R 100," and he it was who guided the latter vessel during the successful trip to Canada in July and August last. He was organiser, and, at the time of his death, Deputy Master of the Guild of Air Pilots and Air Navigators of the British Empire. He had also served for some time as an Air Ministry Examiner for navigators' licences.

LIEUT.-COMMANDER N. G. ATHERSTONE.

The First Officer was Lieutenant-Commander N. G. Atherstone, A.F.C., R.N. (Rtd.). He was born in St. Petersburg in 1894, and he attended no less than three schools—Larchfield, at Helensburgh, Winton House, Winchester, and Charterhouse. In 1913 he entered the Royal Navy as a cadet, and received his training in H.M.S. "Highflyer." During the first three years of the war he saw service in H.M.S. "Gibraltar," with the Cruiser Squadron of the Grand Fleet, and with destroyers. In 1917 he was transferred for service with airships and was made pilot of S.S. "Zero" and N.S. types of non-rigid vessels. A year later, he was made First Officer of the "R 29" and given the Air Force Cross. The next year he returned once more to the Navy, but only remained until 1920, when he retired from the Service and went to live in Australia. Six years later he was promoted Lieut.-Commander R.N. (Ret.) and in the following year he came back to this country in order to take up an appointment for airship duties at Cardington. Two years later he was made First Officer of the "R 101."

FLYING OFFICER M. H. STEFF.

Flying Officer M. H. Steff, R.A.F., was the Second Officer of the vessel. He was born at Luton in Bedfordshire in 1896, and entered the Royal Navy in September, 1914. He saw service in H.M.S. "Inflexible," and went through the Battle of Jutland in 1916. Early in 1918 he was made Flight Officer in the Kite Balloon Section of the Royal Naval Air Service, and was sent to Italy in connection with the Adriatic Barrage Kite Balloons, afterwards—in 1919—being engaged in minesweeping in the Ægean Sea, the Dardanelles, and the Black Sea. The following year he was placed on the instructional staff of the School of Balloon Training in this country, a position which he held for four years. In 1925 he was seconded from the Royal Air Force for airship duty to the Cardington Works, where he carried out kite balloon experiments. In 1929 he was made Second Officer of the "R 101," and, having been lent for the purpose, he acted as Second Officer in the "R 100" during her flight to Canada and back this last summer.

M. A. GIBLETT.

Mr. M. A. Giblett, who was serving as Meteorological Officer, was a man who had had much experience in meteorological matters. He was born at Englefield Green, and was educated at Reading and in London University. During the war he served as Meteorological Officer with the Royal Engineers in the North Russian Expeditionary Force at Archangel. In 1919 he entered the Meteorological Office of the Air Ministry. Saving for a time during 1921 when he was lent for duty with the airships "R 80," "R 36," and "R 38," during trial flights, he served in the Forecast Division at the Ministry till 1925. He was then appointed Superintendent of the Airship Services Division in the Meteorological Office, which had just been initiated. He acted as Meteorological Officer in the "R 100" during her Canadian flight.

PASSENGERS.

LORD THOMSON.

Christopher Birdwood Thomson, who was the third son of Major-General David Thomson, R.E., was born on April 13th, 1875. He was educated at Cheltenham College, and proceeded from there to Woolwich, from which he passed into the Royal Engineers with a Commission in March, 1894. He first saw active service in Mashonaland in 1896, subsequently going through the Boer War and, among other things, taking part in the relief of Kimberley. His services were so distinguished that on attaining Captain's rank he was promoted Brevet-major. In 1902 he was made assistant instructor in the Engineering School at Chatham. Then, after several years' service in West Africa, he entered the staff college, the Commandant at which, for the time being, was Sir Henry Wilson, who later became Field Marshal. Sir Henry evidently took a great fancy for his pupil, and when he—Sir Henry—was given the post of Director of Operations at the War Office, he offered him a post in his branch, which, of course, he accepted.

In 1912, during the Balkan War, Thomson was sent to be with the Serbian Army, and accompanied it through the war with Turkey and later with Bulgaria. He returned to this country in 1913, and in 1914 he went to France with Wilson on the Headquarters Staff of the Expeditionary Force. There, he, first of all, acted as liaison officer, and afterwards was for short periods first with the Belgian Headquarters staff and afterwards with the staff of the First Corps of the British Expeditionary Force, returning eventually again to General Headquarters. In 1915 he was sent as Military Attaché to Bucharest, being placed, when Rumania entered the war, at the head of the British Mission, in which position he personally supervised the destruction of the Rumanian oil wells and stores to prevent them from falling into the hands of the Germans. In that work he was ably assisted by the late Sir John Norton-Griffiths, whose tragic death we had to record in our issue of last week.

In May, 1917, Thomson was back again in this country, but he was not destined to stay long there. After a short time at the War Office he was dispatched to Palestine as C.R.E. of the 60th Division, with the rank of Lieutenant-Colonel. For his services in that sphere of action he received the D.S.O. Early in 1918 he again passed through England on his way to France, his services having been requisitioned by Sir Henry Wilson to assist him on the Supreme War Council at Versailles. There he remained till the autumn of 1919, his rank being temporary brigadier-general. The same year he was created C.B.E.

He then sent in his papers, having decided to enter the political arena, and, though he did not actually succeed in being returned by any constituency to the House of Commons, he attached himself to the Labour Party. After proceeding on several missions in Ireland and abroad for that body, General Thomson was appointed Secretary of State for Air in January, 1924, and was at the same time created First Baron Thomson of Cardington. At the Air Ministry he was a great success, and, among his other activities, which were many, he paid numerous visits, largely by aeroplane, to air stations in this country and overseas. In 1929 when the Labour Party again came into power, he was, naturally, again made Secretary of State for Air.

While holding that office in both administrations, and in the interval between the two, Lord Thomson laboured strenuously on behalf of aviation, and it was he who was more largely responsible than any other person for the Government's taking over airship development. He was a thorough-going believer in airships, and an advocate for the use of heavy-oil engines for their propulsion.

Lord Thomson was the author of several books, one of them being "Air Facts and Problems," which was published in 1927.

SIR SEFTON BRANCKER.

William Sefton Brancker, who was born on March 22nd, 1877, was the son of the late Colonel W. G. Brancker, C.B., R.A. He was educated at Bedford School and went from there to the Royal Military Academy, Woolwich. As his father was in the Royal Artillery, and as his mother was, herself, the daughter of a Major-General of Artillery, it was not unnatural that the young man should choose to be a gunner. Accordingly, we find him receiving a Commission in the Royal Artillery in 1896. From 1900 to 1902 he was in South Africa, serving, during the Boer War, with, first, the Horse, and then the Field Artillery. He was wounded and was mentioned in Dispatches. For the next nine years he was in India with the Artillery, and, during that time, he held several Staff appointments.

It was while there that Brancker had his first introduction to flying. In 1910, or early in 1911, he had to make a flight in an aeroplane as a military observer, and he was so impressed with the possibilities of aviation, that practically all the remainder of his life was devoted to fostering it. Nor was he backward in embarking on his new endeavour, for after holding a War Office appointment in this country for a short time in 1913–1914, he was, soon after the outbreak of the Great War, made Deputy Director of Military Aeronautics. During the years 1916–18, he was, successively, Director of Air Organisation; Commander of the R.F.C. in the Middle East, and Controller-General of Equipment and Master-General of Personnel on the Air Council. He also saw the change of the R.F.C. to the R.A.F., and in 1918 he had become Major-General in the latter Arm.

The War over, the question of civil aviation came to the fore, but it did not progress in this country as rapidly as Brancker thought it should, and as he firmly believed it could. He therefore decided to resign his Commission and himself to lend his aid in furthering it. He resigned his post as Master-General of Personnel in the Air Ministry early in 1919 and joined forces with Mr. Holt Thomas in the "Airco" Manufacturing Company. That company, in August of that year, started the first regular aeroplane service between London and Paris. Earlier in the year Brancker had the satisfaction of witnessing the creation of a Civil Aviation Department of the Air Ministry, and he hailed it as a step in the right direction for the cause he had so deeply at heart. Meanwhile, he never lost an opportunity of speaking in favour of the commercial possibility of aircraft, and to him is attributable much of the increasing interest which has been taken during the past ten years in aviation.

In 1922 there came his way the offer of a Government appointment, by holding which Brancker thought that he would be better able to promote commercial aviation than he could as a member of the public. He was offered and accepted the post of Director of Civil Aviation to the Air Ministry—in succession to Sir Frederick Sykes—a position which he continued to hold until his death. He entered upon his new duties with his customary energy, never losing an opportunity to extol flying and to expatiate on what could be done with aircraft. He made numerous journeys by air in this country and abroad, the most important of which, perhaps, was that which he made to India and back in the winter months of 1924–25, all, save the voyage between Calcutta and Rangoon, which was made by steamship, being effected by aeroplane. He was piloted by Mr. (afterwards Sir) Alan Cobham. His main purpose on that particular trip was to survey the proposed airship route, and to select a suitable site for the Indian base for that undertaking. He did, in addition, much useful inspection work in India, and visited Berlin on his way home in order to confer with the officials of the Air Department of the German Ministry of Communication with a view to arriving at a satisfactory agreement regarding the passage of alien aircraft across German territory. In all, his journey on that occasion extended to some 17,000 miles. His work at the Air Ministry won commendation on all sides, and his loss will be felt deeply, not only there, but by the whole country at large.

Sir Sefton was created Knight Commander of the Bath in 1919, and was gazetted Air Vice-Marshal in 1924. He acted as British Representative on the International Commission of Air Navigation, and had been Vice-President of the Institute of Transport and Chairman of the Racing Committee of the Royal Aero Club.

LIEUT.-COL. V. C. RICHMOND.

Lieut.-Col. V. C. Richmond, O.B.E., B.Sc., A.R.C.S., F.R.Ae.S., was Assistant Director of Airship Development, and, as head of the design staff at the Royal Airship Works at Cardington, it was he who was responsible for the design of the "R 101."

Colonel Richmond was born at Dalston in January, 1893, and obtained his engineering training at the Royal College of Science. Later, he was employed by S. Pearson and Sons in connection with physical and structural problems met with in dock construction. In 1915 he joined the Royal Naval Air Service, and was engaged during the whole of the remainder of the war principally on the building of non-rigid airships. In 1920 he accompanied the Inter-Allied Commission of Control to Germany, and, during part of the time he spent in that country, he was in charge of the Naval Sub-Commission for the surrender of airships and seaplanes.

In 1921 he joined the Airship Research Department of the Air Ministry and for two years thereafter he was occupied in investigating problems arising in connection with rigid airship construction. During 1923 and 1924 he was in charge of the Material and Research Branch at the Ministry, under the Director of Research. In 1923, and since, he had been Lecturer in Airship Design and Construction at the Imperial College of Science. He was, indeed, regarded as the leading authority in this country of the subject, and his paper—entitled "Development of Rigid Airship Construction"—presented at the recent meeting of the British Association at Bristol, was a masterly review of the question.

Colonel Richmond went to the Cardington Works in 1924 as officer in charge of design and research, and, in the intervening period, the "R 101" was designed and built. This year he was appointed Assistant Director (Technical) at the Works.

MAJOR GEORGE HERBERT SCOTT.

George Herbert Scott was born at Catford in Kent in 1888. He received his education at Richmond School, in Yorkshire, and at the Royal Naval Engineering College at Keyham. For the next six years after leaving the latter establishment, he followed the profession of an engineer, but on the outbreak of the Great War, he entered the Royal Naval Air Service as a Flight Sub-Lieutenant. He first of all gained experience at Farnborough with H.M. airship "Eta," and afterwards at Kingsnorth. He was then sent to the Barrow Station, where he was put in command of the airship "Parseval P 4," then the largest airship which the country possessed and which had a gas capacity of 450,000 cubic feet. That was in 1915. The next year he was put in command of the Anglesey airship station. In 1917 he was made Captain of the first rigid British airship, the "R 9," and he was also appointed Experimental Officer, Airships, at Pulham.

In the following year he was given the command of the rigid airship "R 34" and was also awarded the A.F.C. When the Royal Air Force was constituted he was given the rank of Major.

Few, if any, persons had had more airship flying experience than had Major Scott. He was the first to navigate an airship—the "R 34"—safely across the Atlantic and back again. It was a magnificent feat. The westward voyage was made between East Fortune in Scotland and Hazelhurst Field, Mineola, in the United States, that place being reached on Sunday, July 6th, 1919. The return journey, which was begun three days later, terminated at Pulham, in Norfolk, in the early morning of July 13th. Both voyages were entirely successful, and Major Scott's skill was unstintingly praised on all sides. To mark his achievement he was created C.B.E.

Later in the same year—1919—he was demobilised from the R.A.F., and in the following year he obtained a position on the technical staff at the Royal Airship Works at Cardington. His work there was of the highest importance in connection with the design and navigation of airships, and he will always be remembered as being the originator of the idea of the mooring tower, which has now been adopted as standard by the Air Ministry. The introduction of these mooring towers have made it possible for an airship to ride at anchor in the air, as it were, for long periods without the necessity of being taken from and replaced in its shed for each voyage.

The mooring tower at Cardington, which was developed from Major Scott's ideas, was fully illustrated and described in our issues of March 11th and 18th, 1927.

In 1924 Major Scott was appointed Officer in Charge of Flying and Training in the Airship Directorate, and early this year he was made Assistant Director (Flying). As a result of a visit which he made to Canada some years ago to confer with the Canadian Government officials in charge of aviation matters, an airship base, equipped with a mooring tower similar to that at Cardington, was created at St. Hubert, Montreal. More recently he had been engaged in trial flights with the airships "R 100" and "R 101," and he was Officer in Charge when the former vessel made its successful flight to Canada and back in July and August last.

Major Scott was a man who, when piloting an airship never lost his head or his presence of mind, even in times of the greatest stress, and, possibily, he was the foremost airship pilot of his time. For that reason and because of his extraordinarily intimate knowledge of all matters concerning airship construction and navigation, his loss may be regarded as being irreparable.

WING COMMANDER R. B. B. COLMORE.

Wing Commander R. B. B. Colmore, O.B.E., R.A.F., was born at Portsmouth in 1887. He went to school at Stubbington House, Fareham, and afterwards entered H.M.S. "Britannia." He became a Lieutenant in 1909 and two years later left the Navy. The outbreak of the Great War saw him again in service, however, with the rank of Lieutenant-Commander. In 1914 he was with the Armoured Car Division at Antwerp, and later served with armoured cars both in Gallipoli and Egypt, where, in 1915, he was in command during the first campaign against the Senussi. In 1916 he was transferred to the Royal Naval Air Service—Airship Section—going first to the Barrow Station and afterwards to that at Mullion. While there he devised a system for coping with the submarine peril by means of airships, aeroplanes, seaplanes, and surface vessels. The system proved to be very successful, and, with a view to its being applied along all the British coast line, Colmore was made 1st Class Staff Officer, Aircraft Operations, Plymouth. In order to widen the scope of the application, he afterwards became Chief Staff Officer, Aircraft Operations, with the Commander in Chief of the Grand Fleet, his base being at Dundee. The cessation of hostilities rendered unnecessary the putting of his scheme into full operation.

When the R.A.F. was constituted, Colmore received the rank of Lieutenant-Colonel. At the termination of the War he was given a permanent commission as Squadron-Leader R.A.F., and was attached, as Staff Officer for Airships, to the department of the Controller-General of Civil Aviation at the Air Ministry. In 1924 the Government decided to continue the development of airships, and he was appointed Deputy Director of Airship Development in the Department of the Air Member of Council for Supply and Research. That position he held until the early part of this year, when he himself became Director, and was responsible for all airship activities.

The new Canadian Pacific liner, "Empress of Britain," which was launched in June last by the Prince of Wales, will carry one of the latest Marconi short-wave wireless telephone installations when she enters the Atlantic service next year. The equipment will allow passengers to communicate with telephone subscribers in Europe, Canada and the United States through appropriate land stations. The input power to the transmitter will be 20 kilowatts, and the installation will be similar to that used recently by the Marchese Marconi on his yacht "Elettra."

The Iron and Steel Institute.

AUTUMN MEETING IN PRAGUE.

No. IV. (*Conclusion*).*

VISITS.

Vitkovice Works.

The Vitkovice Works of the Vitkovice Mines, Steel, and Iron Works Corporation, which were visited by the members of the Iron and Steel Institute on the occasion of their recent tour in Czechoslovakia, are situated in the Ostrava-Karvinná coalfield at the eastern boundary of Moravian Silesia. The annual output in this region, in which the Corporation owns and works eight collieries, was in 1929 12,560,000 tons, consisting in the main of high-grade bituminous coal containing 6 to 7 per cent. of ash, less than 1 per cent. of sulphur, and having a calorific value of 8060 calories. A large proportion of the output of the largest coal mine belonging to the Corporation—the Caroline Pit—is coked at the mine itself, which is in convenient proximity with the works. At this plant, which has a daily coke capacity of 2000 tons of blast-furnace, foundry and small coke, there are four batteries of Koppers regenerative ovens, of which the most recently installed, is a battery of seventy-five ovens, each 36·5ft. long, 11ft. high, and 18in. wide, capable of taking a charge of 12·5 tons of dry coal and producing 10 tons of coke per day. Altogether there are at the Caroline Pit 216 ovens, while at the ironworks there are two additional batteries of forty and thirty ovens respectively, of which the latter and newest was installed last year and consists of Koppers combination—twin—ovens, each 50·6ft. in length, with a coke production of 15 tons daily. To the plant at the Caroline Pit is attached a Baum coal washery to treat 2000 tons of raw coal daily and a complete by-products recovery plant. About one-third of the coke is dry cooled on the Sulzer system and 1100 lb. of steam at a pressure of 260 lb., and at a temperature of 350 deg. Cent., produced per ton of coke. The coke produced is of small size, but dense and resistant to crushing. Throughout the blast-furnace practice of the Vitkovice works, the utmost attention is paid to grading the size and physical and chemical properties of the materials charged, and the coke made gives, in these circumstances, excellent results from the point of view of the economical and efficient working of the furnaces. The sulphur in the coke runs to less than one half of 1 per cent.

At the Caroline plant has been installed one of the only three Löffler high-pressure steam plants hitherto put into service on the Continent. It is fired by means of low-grade pulverised coal. The colliery waste containing up to 30 per cent. of ash can be treated perfectly satisfactorily in this plant, which has now been in operation for over three years, night and day, without any difficulties or stoppages. It produces per hour 15 tons of steam at 110 atmospheres pressure (1565 lb. per square inch), at a temperature of 500 deg. Cent., steam being raised in the first place in five Carbo boilers at 120 lb. per square inch. A steam pump pumps the saturated steam from the evaporator at 1850 lb. pressure and forces it through a superheater, which raises it to the temperature stated. The superheater consists of two parts, of which one is directly heated by the radiated heat from the combustion chamber, the other being placed in the first duct. In the second flue are placed an economiser and an air preheater. The feed water is preheated by the exhaust from the circulating pump to 100 deg. Cent., and further raised to 260 deg. Cent. in the preheater. Behind the preheater is placed an air preheater which raises the temperature of the air for combustion to 200 deg. Cent. In this plant the problem of heat-resisting materials with low creep, and maintaining reasonably their tensile strength at the high temperatures and pressures attained appears to have been satisfactorily solved. The boiler parts are made of ordinary carbon steel, with a tensile strength of from 38 to 40 tons per square inch, with the exception of the tubes of the radiation superheater, which are of molybdenum steel. The bolts are of nickel-chromium steel. The water used in the boilers is chemically treated to secure the degree of hardness found advisable. The plant is shortly to be increased by the addition of two more Löffler boilers capable of evaporating 75 tons of steam each per hour.

After inspecting the coking plant at the Caroline Mine, and the high-pressure steam plant briefly described above, the members were taken to the blast-furnace plant of the Vitkovice Works, which is connected with a further blast-furnace plant called the "Sofia" plant, at Moravska-Ostrava, by a cold blast main, and a gas pipe line, each ¾ mile in length, forming part of the elaborate distributive system in vogue at these works, which has resulted in an aggregate increase in fuel economy and efficiency generally. The two blast-furnace plants being thus in direct organic connection may, for greater convenience, be described together.

There are in all five blast-furnaces, equipped with nineteen stoves, and blast is provided by a battery of eleven blowing engines, ten internal combustion engines, and a steam engine. In the stoves the blast is heated to between 850 deg. and 950 deg. Cent.

* No. III. appeared October 3rd.

The ores smelted at Vitkovice are derived from the Corporation's own spathic and brown iron ore mines in Slovakia and in Northern Hungary, supplemented by ores from Styria, Sweden, and elsewhere. The firm owns its own magnetite mines at Koskullskulle, near Gellivare, and has manganese mines near Poprad, in Czechoslovakia. The average daily production of the four blast-furnaces working on ordinary burdens—foundry, basic, and hematite pig iron—is 600 tons of pig iron each per day, but the largest has an average production of 850 tons per day. All ores charged are carefully graded and the fines are sintered in a Dwight-Lloyd plant, wherein likewise the pyrites is, after treatment for the removal of the copper, nodulised before charging into the furnaces. Ferro-manganese and spiegel are made in a small blast-furnace, the capacity of which is 350 tons per day. All materials of the charges at the blast-furnace plant are delivered at the furnace tops by bucket hoists, and the annual production of pig iron is 750,000 tons. The coke consumption, on ordinary grades, is about 16½ cwt. per ton of pig iron.

Waste gas and heat economy are the subject of the utmost thought and research at the works of the Corporation, and the system of mixing and apportioning the gases to the specific requirements of the various departments has been made the object of the most careful study. The following table shows the disposal of the coke oven and blast-furnace waste gases, and of the producer gas made, of course, chiefly for consumption at the steel furnaces, but used elsewhere, alone or mixed, in other departments of the works:—

Proportion of make used in	Blast-furnace gas, per cent.	Coke oven gas, per cent.	Producer gas, per cent.
Stoves	27·0	—	—
Boilers	1·2	—	—
Blowing engines	10·7	—	—
Generating current	24·8	—	—
Coke ovens	10·8	—	—
O.H. plant, No. 1	3·6	14·0	31·7
O.H. plant, No. 2	4·1	42·7	55·0
Tube mill	2·2	13·2	—
Fire-brick factory	0·2	3·0	—
Rolling mills	—	14·5	13·3
Other purposes	15·4	12·6	—
	100·0	100·0	100·0

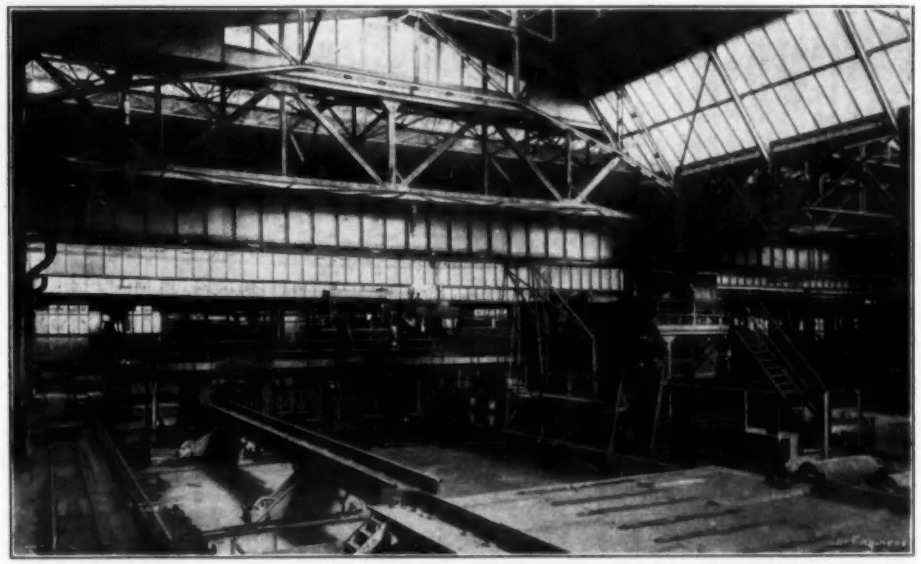
The available production of blast-furnace gas per day is 7,275,000 cubic metres, while the amount of gas produced at the coke ovens is 596,000 cubic metres, and that at the producer plant corresponds to the use of 420 tons of coal daily. Of waste heat boilers at the works there are sufficient provided to represent 8600 square metres of heating surface, which may be estimated as corresponding with a yearly saving of about 100,000 tons of coal.

For the cleaning of the blast-furnace gas there has been installed, in addition to the usual fans, scrubbers, and Theisen washers, a plant for the fine cleaning of gas by electrical precipitation. This has displaced a proportion of the wet cleaning plant formerly employed, but found inconvenient on account of a shortage of the water available at these works.

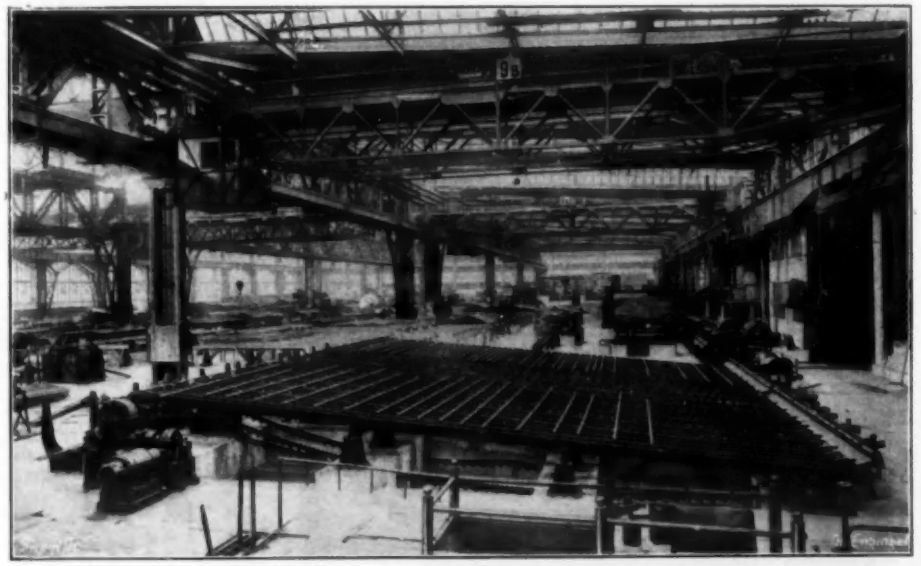
The system now employed is the "Elga," and the existing plant has a capacity of 160,000 cubic metres of clean gas per hour. It is the first plant of its kind in the world to have been adopted for the cleaning of rough to fine gas in one stage. The rough gas contains about 2·2 grains per cubic foot, but after cleaning only 0·013 grain per cubic foot. The principle involved in this plant is as follows:—The dust-laden gas is subjected to the field of a series of electrodes, which are arranged to maintain a silent or glow discharge—Coronal discharge. Owing to the passage of this discharge the space between the electrodes is filled with gaseous ions, and the dust particles become electrically charged, and, separating from the gas, become deposited on the electrodes, while the current of cleaned gas flows on. The voltage employed is about 45,000, but it depends on the volume of gas to be treated, and upon its condition. The deposited dust is shaken off by a "knocking" device that, from time to time, operates on the electrodes, which are in the form of thin steel wires conducted through tubes, ⅞in. internal diameter, which are shaken simultaneously to free them from the dust which has collected. By introducing certain modifications in the original apparatus, it has been possible nearly to double its capacity and to clean 9,540,000 cubic feet of gas per hour in the plant at present installed. These changes consisted in increasing the series of electrodes, enlarging the insulators, and making some improvements in the knocking arrangement. The power consumption is only about 0·074 kW per 1000 cubic feet of gas treated. The principle is essentially that of the Lodge-Cottrell device for cleaning flue gases in power stations.

For many years past the blast-furnace slag at Vitkovice has been utilised in the manufacture of cement. Of recent years considerable attention has been devoted to the manufacture of bricks, which has been carried to a stage where, from the slag of furnaces working on a basic burden alone, no fewer than 1,300,000 bricks are now being produced annually. The slag, delivered from the furnaces into slag ladles, is conveyed, while still molten, to a casting plant, where it is poured into moulds and left, for about seven days, to cool slowly. The resulting bricks resemble, in appearance and composition, basalt,

VITKOVICE STEEL WORKS



TRAVELLING LIVE ROLLER BED OF 60IN. BLOOMING MILL



INCLINED AUTOMATIC SKID COOLING BED

NO. 2 OPEN-HEARTH PLANT—CHARGING SIDE OF TALBOT FURNACES

NO. 2 OPEN-HEARTH PLANT—CASTING SIDE

and have proved highly successful as paving and building material.

The Vitkovice Works have for many years been favourably known as a pioneer works in regard to steel-making practice. When a party of members of the Iron and Steel Institute visited the works in 1907, after the Autumn Meeting of the Institute in Vienna, the Talbot process, then in its early development, was about to be installed, for the first time on the Continent. The duplex process of steel-making had been worked out for many years previously, and at the time of the visit referred to had just been discarded as unsuited to the products of the works. The reputation thus acquired has been fully maintained in the years which have passed since the war, when the works were very greatly extended, and their capacity increased. The steel department now consists of two distinct sections—open-hearth plant No. 1, which is devoted to the making of steel for the steel foundry and forging departments adjacent thereto, and open-hearth plant No. 2, which is a still larger and newer plant devoted to the making of steel for the rolling mills.

Open-hearth department No. 1 now houses five 35-ton open-hearth steel furnaces, one of 15 tons capacity and two 1-ton Heroult electric furnaces. For the service of the open-hearth plant there is a battery of nine coal-fired producers, and the output of this department, which amounts to 125,000 tons of steel annually, is either used direct for castings or teemed into ingots for the heavy forging department.

The steel foundry is under the same roof, the core, and mould drying ovens being fired by blast-furnace gas, and all the operations of steel-founding being supplemented by as much labour-saving machinery, cranes, conveyors, &c., as possible. The forging department contains a 4000-ton press built twenty-five years ago by Davy Brothers, of Sheffield, which for some years past has been worked at a higher steam pressure than that for which it was originally designed, and is now capable of developing a pressure of 5000 tons. Four furnaces with waste heat boilers, and a fifth with a movable carriage, serve this press. A new press by the same firm is now being installed. This press, at 142 lb. per square inch, will develop a pressure of 6000 tons, but by using steam at 170 lb. per square inch a pressure of 7200 tons can be attained. It, too, will be served by four furnaces, fired by coke oven or by blast-furnace gas or by a mixture of both. The cranes installed for handling material at the new press can take loads of 125 tons, and two of them working together will enable forgings of 250 tons in weight to be manipulated at the press. A number of smaller presses, and of hammers, are installed in the forging department, which has an output capacity of 16,000 tons of heavy forgings per annum.

Open-hearth plant No. 2 is now the most considerable melting shop department at the Vitkovice Works. It comprises three stationary open-hearth furnaces of 60 tons capacity each, a Wellmann furnace of the same capacity, two 200-ton Talbot furnaces, and a converted mixer which has been turned into a 200-ton furnace similar to a Talbot furnace. Nos. 1 and 2 furnaces are used chiefly for the production of soft and medium hard steels, the charges consisting in the main of 50 per cent. pig iron, charged molten, and 50 per cent. scrap. About 190 lb. of lime and 120 lb. of ore are added per ton of steel, and these 60-ton furnaces produce on the average about 224 tons of steel per twenty-four hours. The life of a furnace is about 350 charges.

Furnace No. 3, which has a capacity of about 180 tons, and furnace No. 4, the capacity of which is about 150 tons, are both of the tilting type, and work on charges of 80 per cent. pig iron and the rest scrap. The lime consumption is about 250 lb., and that of ore about 285 lb. per ton of steel. In ordinary practice these two furnaces tap alternately about 65 tons, leaving the residue in the furnace to start the next charge. They are basic lined and the average production per twenty-four hours is 300 tons in the case of No. 3 and 280 tons in the case of No. 4, while the linings last for about 400 charges. The molten metal is delivered to these furnaces and handled by a balanced 50-ton crane, the ladles being tipped and the metal poured into the furnaces. The four remaining furnaces, each rated at 200 tons, are charged with 85 per cent. pig and the rest scrap. They are all basic lined, and produce a wide range of steels, including dynamo sheet qualities containing up to 1·8 per cent. of silicon. The outputs of these furnaces per twenty-four hours is about 560 tons each, and the resulting slag runs about 14·5 per cent. P_2O_5. Heat is supplied by a mixture of producer gas with coke oven gas, and all four furnaces have water-cooled ports, and similarly cooled masonry arches between the air and gas channels, and are provided with waste heat boilers.

There are twelve gas producers fitted with Chapman charging devices, and each is capable of gasifying from 21 to 22 tons of coal, with about 8·5 per cent. of ash and 30 per cent. of volatile matter.

The rolling mill equipment at the Vitkovice Works has an annual capacity of 600,000 tons of steel, and comprises plate and sheet mills—including an armour mill—section mills, and small rod and merchant mills. The blooming mill has rolls 60in. in diameter, turned with four grooves and one box pass, for the production of slabs. It is driven by a 5400 nominal H.P. motor and 670ft. torque maximum, by means of an Ilgner energy transformer. Ingots are roughed down to about 6in. by 6in., and taken to a double stand reversing mill, which turns out girders, rails, and large angles. There is another reversing mill adjacent to the latter for the production of tube billets and a universal rolling mill for strip. The mill furnaces are for the most part fired by pulverised coal. Other mills at Vitkovice include three Morgan mills, three finishing mills, a universal mill, and a hoop mill, all driven electrically. There are also two mills for rolling heavy plates, up to 80 tons in weight, a mill for rolling plates of medium thicknesses, and two sheet mills.

Our illustrations—page 405—give two views of the mills, One shows the heavy travelling bed of the blooming mill and the other the "Demag" type—modified—cooling bed of the bar mill, Two other views show respectively the charging and the tapping sides of the "No. 2" open-hearth plant.

A Broadcasting Station for Poland.

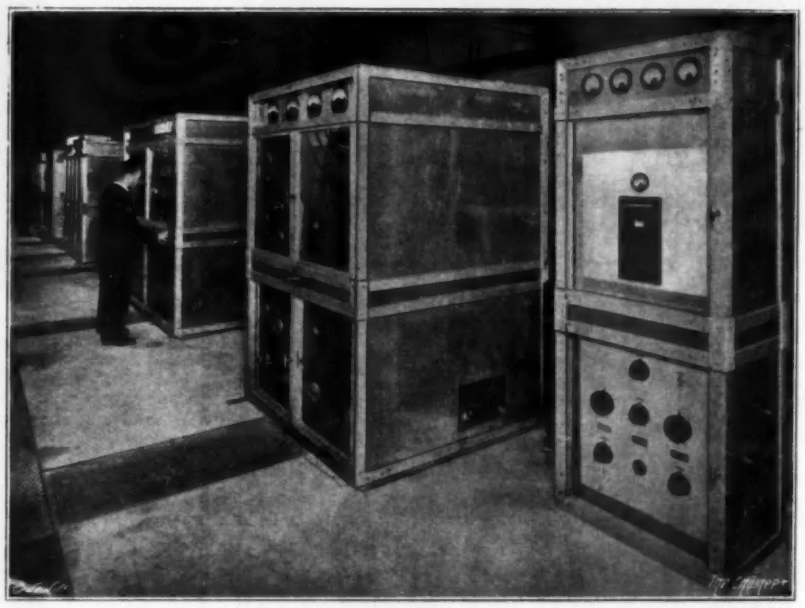
The long-wave broadcasting station which is shortly to be erected near Warsaw for the Polish Broadcasting Company will be the most powerful broadcasting installation in Europe. At present it is undergoing its final test at the Marconi Works, Chelmsford, where it was manufactured, and in due course it will be dispatched to Poland and will be erected at Rasin, about 20 kiloms. from Warsaw, well known as the scene of a battle famous in Polish history. The station will be more than 150 times as powerful as the first 2 LO station, which delivered 700 watts to the aerial.

The aerial at Rasin will be of the half-wave type, terminating in a feeder house underneath the aerial and feeder lines from the transmitter hall to this feeder house will convey the energy to the aerial, carried on two masts, 600ft. high and spaced 750ft. apart. The masts will be the highest in use at any European broadcasting station. The various parts of the transmitter, which will operate on 1411 m., are contained in aluminium and glass panels, completely screened from one another to prevent interaction. In the main or last stage magnifier, eight 100 kilowatt valves will deliver the modulated energy to the aerial, and at 80 per cent. modulation the energy will amount to 158 kilowatts. Normally six of these powerful valves will be used, the total primary energy required to operate the whole of the equipment amounting to 700 kilowatts. The modulation has a straight-line characteristic throughout a frequency of from 30 to 10,000 cycles and should, therefore, give good quality. In order to ensure that the station shall remain accurately on its allotted wavelength and to prevent it from interfering with other transmissions on neighbouring wavelengths, a valve drive of absolute precision is provided.

The three-phase power supply will be rectified by a Brown-Boveri mercury-arc rectifier of 550 kilowatts capacity and will deliver rectified current at from 8000 to 16,000 volts, but since the rectifier equipment will be in duplicate, more than 1000 kilowatts of rectified alternating current will be available. Special land line gear of the latest type has been manufactured to link the Warsaw studios with the transmitter. High-class land line apparatus for simultaneously operating the high-power station at Warsaw and the other broadcasting stations at Lwow and Wilno is also being provided.

This latest Marconi product, combining the latest technical achievement and the finest example of British workmanship, presents a striking instance of the progress made within the last ten years in the sphere of broadcasting. A comparison with the original transmitter which was used on the top floor of Marconi House to initiate the opening of the official broadcast service of the British Broadcasting Company on November 14th, 1922, and illustrated in our last issue, shows the immense strides made in broadcasting technique during the last eight years and the manner in which the Marconi Company is maintaining British prestige in this industry. The high-power transmitter is shown in the accompanying illustration.

HIGH-POWER WIRELESS TRANSMITTER FOR WARSAW



WIRELESS INSTALLATION FOR TANKS AND ARMOURED VEHICLES.

A portable wireless apparatus intended for communicating over short distances from tanks and other armoured fighting vehicles has been designed by Marconi's Wireless Telegraph Company, Ltd., which has applied to it the name of type S.B.1a.

It is an ultra short-wave portable installation, operating on between 7 m. and 8 m., designed for telephony and telegraphy, to be used either as a permanent fitting in armoured vehicles or as a portable set for trench and other advanced military positions to which it can easily be carried. The aerial, which is almost invisible, consists of a copper-plated steel rod, 12ft. in height and made in four sections. In use it is liable to be subjected to severe swaying and bending, but it is designed to be very flexible and so as not to buckle. A feeder cable connects the transmitter to the aerial system, which is connected to the body of the tank or to "earth" through a balancing coil, so as to permit the maximum amount of energy to be transferred to the aerial for the wave length in use.

The transmitter and receiver are fitted in a teak instrument case, and are said to be very simple and easy to operate. When the set is fitted in a moving vehicle where jars and shocks would cause damage, these vibrations are provided for by shock-absorbing slabs of sponge rubber. Power for the transmitting valves is supplied by a rotary transformer, driven by a 12-volt accumulator, and delivering 600 volts to the anodes.

For telephony the choke control system of modulation is used, and, for telegraphy, an interrupter disc mounted on the shaft of the rotary transformer enables the tonic train system of transmission to be employed. Four valves, two oscillators and two modulators are used in the transmitter, and four valves are used in the receiver, the last two stages being note magnifiers.

An innovation for land vehicles is the system of intercommunication and dual control which was previously confined to aircraft apparatus. It allows the wireless apparatus to be switched off and two people in the vehicle to communicate with each other by means of the telephones, or, alternatively, either of them can operate the wireless equipment. When communicating with each other the last two stages of the receiver are brought into use as speech amplifiers.

The Development of the Bridge.—At the opening meeting of the fiftieth session of the Junior Institution of Engineers, Mr. S. J. Crispin, of Cornwall, gave an illustrated lecture tracing the development of bridge construction from the primitive method of bridging a stream by felling a tree across it to the structures recently placed across the Tyne and that now being completed across Sydney Harbour. In tracing the evolution of the three main types of bridges, viz., the girder bridge, the suspension bridge, and the arch bridge, the lecturer showed many examples of wood, stone, wrought and cast iron and steel construction to be found in Cornwall, where the genius of Brunel as a bridge designer was prominently displayed. In comparing the relative advantages in stone bridges of those employing Gothic or pointed arches and semi-circular arches, he showed, by superimposing arches of both types of equal span the distribution of stresses caused by a load placed at the same height above each arch, and considered the pointed arch to be more suitable for a load placed directly over its crown, *e.g.*, a church tower, but the semi-circular arch was better for a moving load. The first iron bridge constructed in England, possibly in the world, was at Coalbrookdale, erected by Abraham Darby in 1779. Wrought iron as a bridge building material came after cast iron. Fairbairn first used plates and angles riveted together, this method giving great impetus to iron bridge construction. The suspension bridge in its various forms was illustrated by many examples, concluding with the largest structure of this type now in course of erection, that across the Hudson River at New York. Bridges of the cantilever type comprised the Forth Bridge and the Tower Bridge. The lecture concluded with some interesting details of the construction of the Sydney Harbour Bridge.

A New Type of Terminal Bushing for Extra High Tension.

IN the practical application of lead-in insulators for high and extra high-tension service most designers are inclined towards two types: the ordinary porcelain insulator filled with oil and the bakelised paper condenser type, both of which were dealt with in detail in an article by G. Silva appearing in the *Elettrotecnica* of June 25th, 1927. The first type is composed of two porcelain parts joined together with metal so as to form a tight receptacle which contains the terminal composed of a metal core and a number of bakelised paper tubes arranged concentrically around it, the whole being immersed in oil. This type has various advantages, such as the absence of gases, low losses, good cooling of the solid insulating parts, and, above all, a very high resistance to stresses for long duration, even at pressures little below those stipulated for the one-minute test.

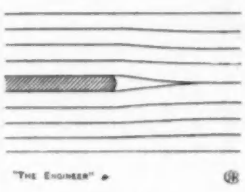
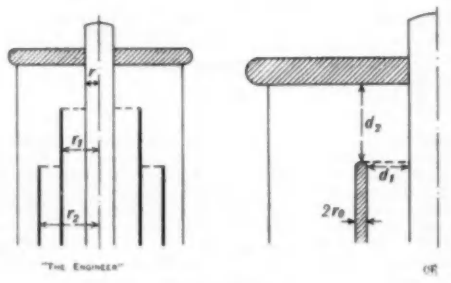


FIG. 1

On the other hand, it has disadvantages, such as a tendency for the oil to leak, and, in consequence, the possibility of reduced dielectric resistance, owing to absorption of moisture from the air, leakage at the collar, and imperfect distribution of potential along its surface. The two latter difficulties have been overcome by including very thin metal shields inside the insulating tube with a view to ensuring practically uniform distribution. The main drawback, however, is the large size, which is the principal reason for the greater cost as compared with other types of bushings. The necessity for large dimensions, and more particularly in respect of diameter, is attributable to the non-uniform distribution of potential both in the radial and longitudinal directions, and it is not possible to reduce these dimensions to any appreciable extent, even in types provided with internal metal shields.

The lead-in insulator of the condenser type is composed



FIGS. 2 AND 3

of a metal core on which layers of bakelised paper are wound concentrically and alternating with layers of metal foil, and the latter, which decrease in length from the centre towards the sleeve, serve the purpose of providing for a definite distribution of potential and eliminates leakage or dispersion. These insulators are of appreciably smaller proportions than the other type, but they present a greater number of disadvantages, such as (1) the necessity of accurate manufacture in order to avoid gaseous inclusions, which, in any case, are difficult to avoid altogether, especially at the end of the metal shield, as it is not possible for the paper completely to fill the space left immediately at the end of the shield—see Fig. 1—which results in reduced compression of the sheets; (2) high

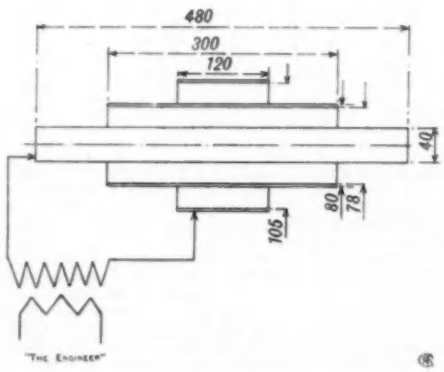


FIG. 4

losses in the dielectric and poor cooling; and (3) the "edge" effect, which is considered to be the most serious defect of the condenser type of terminal, because it entails considerable electric strain on the insulating material, and it is not possible accurately to determine the extent of this defect. In a condenser type insulator, as shown in Fig. 2, the degree of maximum stress at the sleeve or cover is

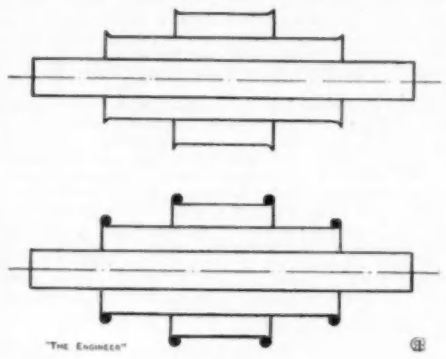
$$g = \frac{E}{r \log_e \frac{r_1}{r}}$$

and the minimum

$$g_1 = \frac{E}{r_1 \log_e \frac{r_1}{r}}$$

where E is the voltage on the element, r the internal radius of the element, and r_1 the external radius of the element.

In practice the difference between r and r_1 is very small, so that the electrostatic field in the dielectric between the two shields at the level of the collar may be taken to be approximately uniform. But the same cannot be said of the electrostatic field at the edge of the shield of radius r_1, because since r_0 is the radius of the edge of this thin shield and is practically equal to zero—Fig. 3—a considerable concentration of the electric field occurs around this edge, both with respect to the distance d_1 and d_2, and, consequently the stress $g\,b$ on this edge will be greater than g. If the system were situated in air instead of the bakelised paper, a stray field would be set up about this edge, tending to increase r_0 until it reached such a value that $g\,b$ would not exceed 21 kV/cm., the dielectric resistance of air. In the case under consideration, however, local heating would be set up, affecting the dielectric constant of the material and tending to reduce the stress at the edge. In all cases greater losses will result, as well as a reduction in the margin of safety. This explains why, in order to avoid



FIGS. 5 AND 6

the visible leakage at the edge of the earthed metal casing, the makers of condenser-type bushings arrange for a metal shield beneath the paper, projecting at least 2 cm. with respect to this casing and connected electrically with it.

In order to examine the behaviour of electrical stresses in condenser type insulators, tests were carried out in the shops of the Soc. An. Officine Elettromeccaniche Scarpa and Magnano, of Savona. Three brass tubes were arranged concentrically, as shown in Fig. 4, and spaced apart by means of insulating blocks and were immersed in a receptacle containing the best insulating oil. The sizes of the tubes were determined by calculation, as adopted in determining the shields for lead-in insulators having a uniform superficial distribution, and were such that at 150 kV the degree of maximum radial stress reached in the oil was 56 kV/cm. After connecting the ends of the secondary winding of a transformer to the inner and outer tubes, as shown in Fig. 4, the pressure was gradually raised, and when a pressure of 50 kV was reached a visible corona discharge was set up in the oil around the edges of the

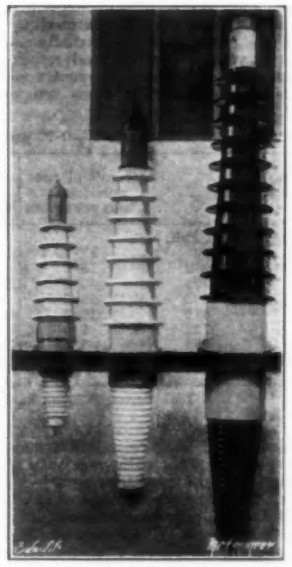


FIG. 7

two shorter tubes, and on the pressure being increased the discharge developed into a mass of crackling sparks, whilst at 78 kV an arc was obtained. This took place on the edge of the tube in a radial direction, but inclined towards the end, thus proving that the stress at the edge is much more intense than it is at the collar. When it is considered that the stress at the collar with 78 kV was 29 kV/cm. and the dielectric resistance of the oil approximately 100 kV/cm., it will be seen how great the ratio is between the stress at the edges and the radial stress at the collar.

It is reasonable to suppose that the distribution of electrical potential in the mass of oil differs but little from that found in a mass of bakelised paper. The results of these experiments explain why designs of condenser-type bushings have to limit the value of potential at the collar so as not to exceed the test pressure of 35 kV/cm., although the dielectric resistance of the material employed is usually 120 kV/cm. and more. The experiments were then extended to tubes with flared ends, as shown in Fig. 5, when the pressure at which a discharge began to appear in oil was increased from 50 to 110 kV and that to produce an arc to 120 kV. The ends of the tubes were then fitted with rings of 2 mm. diameter copper wire, as shown in Fig. 6, when the formation of a discharge was no longer observed, whilst to obtain a flash-over it was necessary to raise the pressure between the rings to 157 kV. On inserting tubes of bakelised paper between the various elements, the conditions did not change to any appreciable extent.

It was noted that in the first case, with tubes with a sharp edge, the breakdown pressure for stresses of short duration increased appreciably—*i.e.*, to 110 kV—but at comparatively low pressures corona discharges were set up, and, starting at 60 kV, attacked the surfaces of the insulating tubes, thus jeopardising the safety of the whole structure.

On the basis of the results obtained, Guiseppe Scarpa has taken out a patent for a new lead-in insulator of a mixed type; that is to say, an insulator filled with oil

FIG. 8

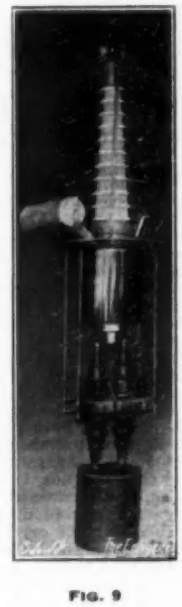


FIG. 9

or compound and of the condenser type, and which may be made either with the external shell of procelain, or of bakelised paper. Important electrical advantages over the ordinary condenser type are obtained, the edge effect and gaseous inclusions being eliminated, whilst it also possesses advantages over the oil-filled type as far as space requirements and price are concerned. The insulator is composed of a series of insulating tubes concentrically arranged with rigid metal tubes inserted between them, and the latter are terminated at both ends by a ring of such a radius as to limit the amount of electrical stress at the edge to an admissible value, the whole being immersed in a compound that is viscous at normal temperature.

The compound settles in the same way as oil, and prevents the inclusion of gas bubbles. It can circulate slowly in the inside of the lead-in insulator and, in addition

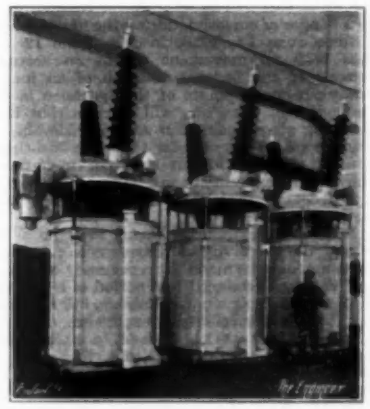


FIG. 10

to eliminating the leakage liable to occur with oil, it is also less hygroscopic and ionisable, whilst its dielectric resistance is greater than that of oil. The advantages of the new device are said to be considerable. It is sufficient to divide the insulator into a small number of elements, which may vary from two to four at the utmost. The surface spark-over pressure reaches values considerably higher than in condenser types of similar dimensions, and the same applies to the puncture voltage. When made entirely of bakelised paper, the new lead-in insulator will stand tests of long duration, *i.e.*, 8 hours on end, at a tension more than 60 per cent. above the normal voltage without the slightest detrimental effect. The 1 minute test can be carried to the maximum stress at the bushing of 90 kV/cm. and the 1 hour test to 60 kV/cm. The insulator is free from discharges at the collar and withstands voltage impulse and high-frequency tests, and its dimensions are very small. Fig. 7 shows porcelain insulators for pressures of 75 to 150 kV, Fig. 8 a vertical leading-in insulator for 150 kV and Fig. 10 a circuit breaker for 150 kV, made by Scarpa and Magnano, and fitted with the new insulators. All these insulators embody a current trans-

former, and Fig. 9 shows an oil-immersed current transformer and insulator for 150 kV, made by the same firm, on which, in addition to the lead-in insulator, the lower insulators are also made in accordance with the new scheme, the rings referred to in the description of the scheme being clearly shown.

A lead-in insulator having the dimensions of the 120 kV type, but fitted in such a manner as to obtain the maximum flash-over voltage, has been tested at 400 kV for 2 minutes, the flash-over voltage being 410 kV. Subsequently, it was tested for four consecutive hours at 220 kV, the magnitude of the electric stress being 93 and 51·2 kV/cm. respectively. The pressure of 400 kV was reached on the same insulator four times on four subsequent days in the presence of engineers representing different firms.

The sole agents in the United Kingdom for these insulators are V. Getgood and Co., of 110, Windsor House, Victoria-street, S.W. 1.

Permanence of Dimensions Under Stress at Elevated Temperatures.*

By Dr. W. H. HATFIELD (the Brown-Firth Research Laboratories, Sheffield).

It will be generally conceded that one of the most difficult problems before the metallurgical and engineering world at the moment is that of determining fundamental data for the use of the designer which will enable him to be certain that the stresses with which he has to deal at elevated temperatures can be carried without deformation.

The author writes under no misapprehension of the difficulties in the way of a complete solution. The study of the properties of steel at elevated temperatures is receiving, much attention as is clearly shown by the bibliography attached and to which works reference can be usefully made; but the study will become easier when agreement is obtained as regards the more simple problems associated with the characteristics at ordinary temperatures. Can one have permanence of dimensions under stress at normal temperatures? Dickenson, Bailey and others assert that there is no absolute permanence; but if this assertion is examined as to their ultimate meaning, qualifications are made which leave the assertion simply in the position of an abstract idea at present incapable of proof or disproof, owing to our inability to deal experimentally at present in an effective way with the time factor. Engineering experience over long periods of time, however, really gives the answer, which is, of course, that for all practical purposes permanence of dimensions under heavy stress is undoubtedly attained within measurable accuracy over very long periods of time. The question is, however, of great interest, and it is, indeed, theoretically necessary to endeavour to establish the fact one way or the other by experiment.

One such experiment is still continuing in the Brown-Firth Research Laboratories, and may be usefully described, since the results are of sufficient interest in their bearing upon the problem. The author recently postulated that, to be sure that a bar 10ft. in length submitted in tension to a given stress would not increase in length by plastic deformation to a greater amount than 0·001in. in a period of twenty years, the rate of flow under that stress must be determined to be less than one twenty-thousand-millionth of an inch per inch per hour. The experiment consists of stressing, at 25 tons per square inch, a strip of cold-rolled rustless austenitic chromium-nickel steel—limit of proportionality, 27·4 tons per square inch; 0·1 per cent. proof stress, 60·7 tons per square inch—the extensometer being constructed also of rustless steel. The selection of rustless materials removes a danger of corrosion during the life of the experiment. Since June 1st, 1929, to date, June 12th, 1930, there has been no movement within an accuracy of measurement of one forty-thousandth of an inch; the length between gauge points of the specimen is 8in. A simple calculation, therefore, will disclose that if movement is taking place under this very considerable stress, it is, at any rate, of a less order than one two-thousand-eight-hundred-millionth of an inch per inch per hour. The nature of this experiment will bring home the extreme difficulty of dealing with the whole question of stability of dimensions.

The time for such an experiment may be shortened by increasing the sensitivity of measurement; for instance, if the measurements be made to an accuracy of a millionth of an inch it may be reduced to a period of a few months. But the effect of temperature variations, inducing changes according to the coefficient of expansion of the steel, requires to be dealt with. Indeed, a casual draught, changing the temperature of a 10in. test-piece 1 deg. Cent., would change the extensometer reading by one ten-thousandth of an inch, a variation of a tenth of a degree would affect the observation by one hundred-thousandth of an inch; therefore, it will be seen that the value of supersensitive measurement of dimensions is entirely at the mercy of the provision of a sufficiently constant temperature. In any case, the reading-off of the actual temperature and of the dimensions must always be synchronised.

There is another aspect of such experiments which cannot be neglected, at any rate in the initial stages of the stressing, namely, the thermal effect of the stress. The adiabatic effect during loading which results in a definite drop of temperature must not be forgotten. Again, if the stress is high enough to cause plastic deformation, the temperature will rise through the heat so generated. It is thus clear that time is necessary for stability of temperature to be attained at any given stress.

The "initial movement" which occurs on loading, prior to the settling-down either of a test-piece or of a structure, is obviously an important item in practice, although the degree of importance will naturally depend upon the exact conditions.

Time obviously plays a part in the extent to which this initial movement is observable in carrying out a test. For example, in the ordinary testing of a piece at room temperature with an extensometer, the determination of the primitive "limit of proportionality" is usually rendered somewhat difficult by doubts due to the limitation of the accuracy of measurement. Since, strictly speaking, the value obtained should represent the point where the slightest departure from proportionality begins to occur the fineness of measurement must be the deciding factor, affecting the result to a very substantial degree. Even the slight elastic stretch of the specimen may affect the bearings of the screw-points fixed on the specimen for measuring purposes, and this may actually cause a premature indication of ultra-elastic extension. The "time" effect—that is, the slow yielding of the specimen in the early stages—must be added to these effects. An ultra-elastic movement in the region of what is thought to be the limit of proportionality may be so small as to escape observation when the speed of testing is normal, but this movement may be so magnified during the testing period in a slow test as to become distinctly measurable, and cause the observer carrying out the test to report a lower value for the proportionality limit. These effects are very noticeable when tests are carried out at elevated temperatures, but are not absent at ordinary temperatures. The amount of initial movement occurring under a given load naturally varies with the stress applied and the nature of the material, and may be attributed to various causes.

Internal stresses left in the piece after heat treatment or machining are an obvious cause for obtaining permanent set at times with relatively low stresses. The applied stress, being additive to the internal stress at certain zones in the sample, causes a local high stress not represented by the normal stress deduced from the load. Local yielding causes a redistribution of the stresses, usually in the direction of equalising them, and after a small initial movement this cause of inequality may disappear. Inaccuracy of the test-piece, lack of straightness, untrue gripping, &c., which should not be present under proper conditions of testing, are not always satisfactorily eliminated. These features operate in the same manner as internal stresses.

Following these factors, we have what may be called the "true" behaviour of the material. The causes of initial movement here are chiefly variations in the orientation of crystals or grains within the mass, deciding whether such grains are favourably or unfavourably disposed for early slipping. Once "slip" has occurred in such crystals, adjustment has occurred within the mass, and the stresses are then redistributed so as to make the further opportunities for yielding more equal amongst the various crystals. This early yielding of certain disposed crystals is most to be expected in materials having a clearly defined crystal structure, such as a mild steel treated to have a fairly coarse structure. The later stages of yielding are controlled, in the main, by the necessary amount of "cold-working" of the specimen by deformation required to raise artificially the stress-carrying capacity to balance the stresses imposed. With certain metals at ordinary temperatures and with practically all materials at elevated temperatures some annealing of the worked condition will occur during the test, especially if it is prolonged, and further yielding may or may not occur.

The severe limitations as regards the absolute determination of possible movement under continued stress, and many factors which may obscure the degree of intrinsic deformation on initial loading, have now been mentioned. It, therefore, remains for the author to state concretely his views, and then to present some experimental evidence which can be judged upon its own merits. That which the designer wishes to know is essentially: (1) Can steels maintain large values of stress and retain permanence of dimensions even at elevated temperatures? (2) What is the permissible stress at a given temperature for a particular steel? (3) If there is initial movement which early comes to an end, what is its magnitude? With regard to (1), the answer is that for practical purposes permanence of dimensions within a certain range of stress is obtained. With regard to (2), permissible stress, suggestions will be found in this paper. With regard to (3), initial movement of consequence in excess of elastic deformation does not really take place within what may be termed the practical elastic range of the material.

The ordinary tensile test, which is the practical appeal of the engineering world, in its most refined "reception test" form, gives the "yield" point as a proof stress which corresponds to a permanent deformation of the specimen within the gauge length of 2in., of 0·5 or 0·1 per cent. This is obviously crude when judged from our present standpoint, but much less so than the ordinary commercial method of judging the yielding of the material. Incidentally, the test is carried out in anything from 1 min. to 5 min, and, therefore, yielding with time is not considered nor to any appreciable degree permitted. These aspects of the ordinary tensile test, when considered as a means of determining the characteristics of a material, must be borne in mind.

The Time-yield.

When considering the response of steels at elevated temperatures—and in this paper the author proposes to deal with temperatures up to 600 deg. Cent. (1112 deg. Fah.)—the characteristic known as "creep" comes into play; that is, the influence of time becomes of great consequence, particularly at temperatures in excess of 300 deg. Cent. (572 deg. Fah.)

The limiting "creep" stress is the stress above which there is a steady continuous creep of a measurable rate within the accuracy of the observer's measurements. Test-pieces are loaded for long periods of time at different values of stress, and the rate of creep to which the pieces settle down is determined. From these rates of creep a curve is drawn from which a close estimate is made of the limiting creep stresses; four to five months are required to obtain a satisfactory value of limiting creep stress at one temperature. Quite clearly, therefore, researches having as their object the improvement of steel as regards an increase in the limiting creep stress, are severely handicapped owing to the great time required for a discriminating examination of steels of varying composition and diverse heat treatments. Incidentally, as will be shown later, the limiting creep stress is a value

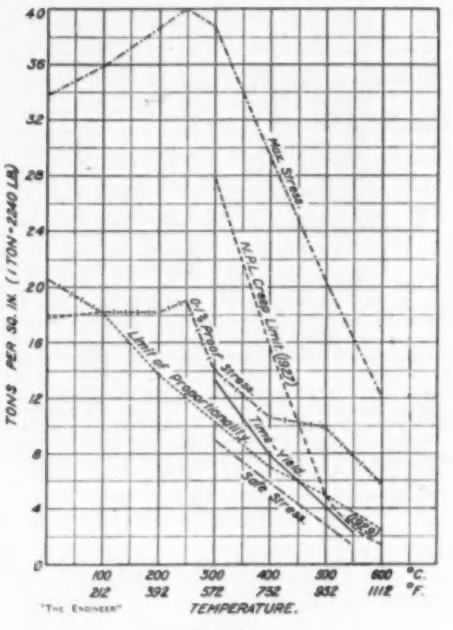


FIG. 1

well within the zone of stress which produces definite plastic deformation, and, hence, knowledge of the value is not in itself of complete service to the designing engineer. What he really wishes to know is the stress which can be safely imposed without change of dimensions within the time in which he is interested. This matter has been dealt with in the author's investigations by arbitrarily deciding the conditions of a standardised test likely to be helpful in this direction. The method adopted consists in discovering, by static loading, the stress within which, at the given temperature, stability of dimensions is attained within a period of 24 hours for a further period of 48 hours with an extension not exceeding the elastic deformation of 0·5 per cent. on the gauge length, and with limitation as regards measurement for permanence of dimensions of the order of one-millionth of an inch per inch per hour. This value the author named the "time-yield." It will be seen that a single test for a given temperature in search of this value is obtained by this method in three days, and the matter is, therefore, brought, in point of time, within the limits which permit a large number of tests to be made in a reasonable period.

TABLE I.—0·25 *per cent. Carbon Steel, Normalised from* 890 *deg. Cent.*

Temperature.		Limit of proportionality, tons per sq. in.	0·1 per cent. proof stress, tons per sq. in.	Yield point, tons per sq. in.	Maximum stress, tons per sq. in.	Elongation on 2in., per cent.	Reduction of area, per cent.
Deg. Cent.	Deg. Fah.						
15	59	17·75	20·6	20·6	33·9	30·0	63·6
100	212	18·3	18·3	18·7	35·95	26·0	61·0
200	392	13·8	18·2	18·5	38·7	18·0	45·0
250	482	12·0	19·0	19·5	40·0	20·0	44·8
300	572	10·5	14·2	15·0	38·7	30·4	50·9
400	752	7·0	10·6	13·9	29·4	35·9	65·3
500	932	4·85	10·0	12·8	20·6	37·0	65·3
600	1112	2·5	5·75	7·5	12·15	62·4	90·5

Test pieces, 0·357in. in diameter × 2in. parallel. Elongation measured on 1¼in.

The author hopes that a general survey of the evidence contained in this paper will lead to agreement as regards his suggestion that if the time-yield is determined in this manner, then a stress, say, of two-thirds of that value can be regarded as a safe stress—that is, one that will produce negligible initial deformation and will not produce change in dimensions with time. It must, however, be emphasised that this suggested "safe stress" refers to the actual stress, and, therefore, imposes upon the designer the extremely difficult task of determining that value. The author has found this method of great service for some time now, in giving opinions as to the safety, or otherwise, of designs in various types of steel applied to a wide range of purposes, put before him by the companies with which he is associated.

Mild Steel.—It is useful to consider, in the first place, the properties of mild steel from the standpoint of the variation in the safe stress range with increasing temperature. For this purpose acid open-hearth steel with 0·25 to 0·28 per cent. of carbon, and a manganese content of 0·65 per cent., will be considered. Such a steel is largely used, and particularly for forgings, solid and hollow, used at elevated temperatures.

The characteristics of this steel may later be regarded as a basis from which to compare data obtained from other steels.

In Table I. will be found a set of figures illustrative of

* Iron and Steel Institute.

the data derived from the tensile test at different temperatures up to 600 deg. Cent. on a 0·25 per cent. carbon steel in the condition as normalised in the form of 1¼in. round bar. It will be noticed that much attention has been paid to the beginning of the range of stress in which plastic deformation occurs—that is, figures are given for the limit of proportionality, for the proof stress at 0·1 per cent. extension, and for the ordinary yield point.

The limit of proportionality has been obtained with measurements of a sensitivity of 0·0001in. The 0·1 per cent. proof stress has been read off the stress-strain diagram. The yield point is the ordinary commercial reading—that is, practically equivalent to 0·5 per cent. extension—and is necessarily somewhat arbitrary, but can thus be compared with similar determinations. A comparison of the figures given in Table I. with tests from heavy forgings, depending upon mass and heat treatment, brings out an interesting feature, namely, that the yield points in Table I. are definitely higher in the lower range of temperature, but that in the higher range of temperature this difference tends to disappear. This is, no doubt, largely explained by the coarser structure and larger crystals in the material cut from the heavy forgings. This earlier yielding with the coarser structure is to be expected at the lower temperatures, but it is of great interest that the same difference does not continue with the higher temperatures.

In Table II. will be found the time-yield values of this steel for temperatures from 300 deg. to 600 deg. Cent. for the normalised condition of the steel in bar form. Values are also given for the annealed condition.

The data derived from tensile tests, and from the special tests, enable the collective diagrammatic presentation of the figures for this carbon steel in the normalised condition to be made in Fig. 1. Stress in tons per square inch is plotted against temperature in both Centigrade and Fahrenheit degrees. The curve of maximum stress takes the form to be expected with a maximum value near to 250 deg. Cent. The proof stress—0·1 per cent. extension—is plotted as the refined form of yield point, and will be found to approximate in form to the curve of maximum stress. The curve produced by the limit of proportionality values shows a slight maximum at 100 deg. Cent., and then falls rapidly. The time-yield values produce a curve which, at 300 deg. Cent., is a little below the proof stress value, but which increasingly diverges in a downward direction from the proof stress curve, cutting across that of the limit of proportionality at a temperature a little in excess of 450 deg. Cent. Thus, the effect of time in the time-yield tests is well brought out. The values produced by the author's suggestion that two-thirds of the time-yield may be taken as the safe stress, result in the production of the curve of safe stress, and the range of stress thus indicated as safe may be considered in direct relation with the other data and, of course, with accumulated experience.

It is of interest to consider these time-yield and safe stress curves with the deductions from the work of contemporary investigators. The very valuable work executed at the National Physical Laboratory enables the "creep" limit curve to be marked out; this curve has been superposed upon the others in Fig. 1. It will be found to commence at 300 deg. Cent., midway between the proof stress and maximum stress—that is, in the midst of the zone of plastic deformation; it subsequently diverges with increasing temperature from the curve of maximum stress, and tends to converge with the time-yield curve when temperatures of 500 deg. Cent. are attained. The relation of the curve to those produced by the other values confirms the author's comments made above. The work of Lea presents, in effect, a higher creep range than that of the National Physical Laboratory. If the work of other investigators is considered, interesting confirmation of the soundness of the present deductions is obtained. Dickenson's work is brought completely into line, since, for instance, a stress of 8·5 tons per square inch at 500 deg. Cent. is nearly double the value of the National Physical Laboratory creep limit, and, therefore, would in the light of our present knowledge, be expected to produce actual rupture with time. The works of Prömper and Pohl, Pomp and Dahmen, Guillet, Galibourg and Samsoen, and Cournot and Sasagawa, all produce data indicating that experimental evidence to date confirms the safe stress values postulated. As regards the well-known research of French, Cross and Peterson, the author suggests that the results appear to indicate that for some reason their values are on the low side.

Carbon and Ordinary Alloy Steels.—In Table II. will be found the time-yield values determined for different steels

Cent. The reading of the change in length and of the temperature is synchronised. This system has been in operation for about five years. Recent machines lately installed in the Brown-Firth Research Laboratories are discussed in Appendix I.

There is one reservation which must be made concerning the determinations made at the higher temperatures—namely, it is difficult to know when the temperature is reached at which structural changes will take place with time in the steel under test. Regarding this serious disability, it naturally follows that the implication is that parts under service conditions at such temperatures would also be so affected. It is difficult to imagine serious structural changes still continuing after stability of dimensions has been attained over 48 hours within the accuracy of measurement employed.

The author has not, as yet, mentioned the serious modification which occurs in the modulus of elasticity within the range of temperature under discussion. The work in the author's laboratories simply confirms the excellent work of Lea, Iokibé and Sakai, Tapsell and Kikuta. Those interested in the question of high temperatures are, no doubt, familiar with the established curves illustrative of the fall in the modulus, which becomes very steep with temperatures in excess of 300 deg. Cent.

The subject of the influence of elevated temperatures upon steel cannot be left without a word as to the resulting corrosion effects. Everything depends upon the nature of the atmosphere to which the steel is subjected, and, therefore, each case must necessarily be considered upon its merits. Researches in this field have been in hand for some considerable time in the Brown-Firth Research Laboratories, and it is hoped to publish some of the results at an early date. In the meantime, reference may be made to one particular case—namely, the effect of steam upon mild carbon steel at high temperatures and pressures. Experiments to date appear to indicate that a layer of oxide is initially formed, which, judged over a short period of time, would indicate a definite scaling factor too considerable to be ignored, but cumulative evidence tends to show that the characteristics of this scale are of such a nature as to protect the steel from progressive attack. It thus appears probable that more complete investigation will show that danger from excessive scaling within the ranges of temperature at present under consideration—up to 1000 deg. Fah. (538 deg. Cent.)—is not likely to be anything like as serious as was at first anticipated. It should, however, be borne in mind that if the scale functions in this suggested protective manner it is essential that local damage, from any cause, be prevented. This is, however, too large a subject to deal with in the present paper.

Inclined Calandria Vacuum Pans.

In the manufacture of sugar from either sugar cane or sugar beet, and in the refining of these sugars, the final concentration and crystallisation is carried out in batches in vacuum pans. Such pans are now built of large size, concentrating up to 80 tons of sugar in one batch. They are arranged for very rapid boiling with low-pressure steam, usually the exhaust steam from the engines driving the machinery in the factories, or that from the turbines used for generating electrical power being employed.

A recent development is to use the vapour from an

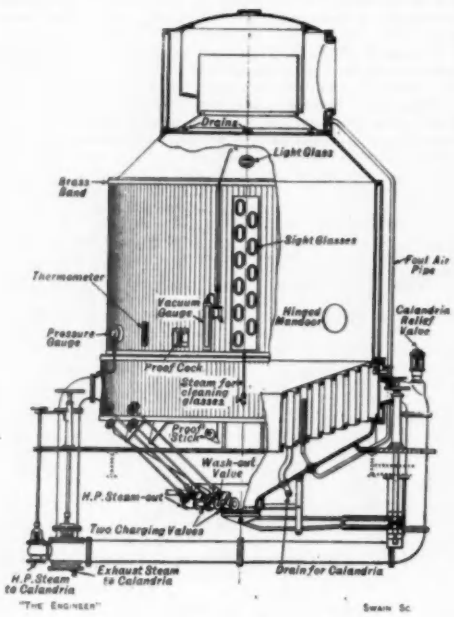


FIG. 1—ARRANGEMENT OF VACUUM PAN

evaporator concentrating thin liquors for the final concentration and crystallisation in the vacuum pan. In this respect a considerable amount of progress has recently been made in the design of sugar vacuum pans, with a view to simplifying the operation and at the same time enabling the pan boiler to produce a better quality of sugar.

One of the latest designs is illustrated in Fig. 1, which drawing shows the inclined type of calandria vacuum pan, as built by The Mirrlees Watson Company, Ltd., of Glasgow. In this pan the calandria or heating element is composed of two conical cast bronze plates, each with a large diameter hole in the centre, in which there is fitted and riveted a copper tube for circulating the boiling liquor. In addition to the central tube, there is also a large number of smaller diameter holes, usually about 4in. diameter, into which are expanded the copper heating tubes. The tube plates are flanged at their outer edges, and a steel wrapper plate, riveted to the flange of the tube plates, forms the outer shell of the calandria. Two or more steam inlets are arranged in the outer shell and immediately opposite to these inlets there are baffle plates, which deflect the incoming steam or vapour to the annulus surrounding the heating tubes, thereby giving a uniform distribution of heating steam around the periphery of the calandria. The heating steam finds its way through the heating tubes to the centre well, at which position there are arranged pipes for the removal of all the incondensible gases and also the condensate. For this particular design the makers claim that a more even distribution of heating throughout the entire calandria, which is most essential for producing an even-grained sugar of good quality, is attained. If

FIG. 2—15FT. DIAMETER VACUUM PAN

local heating is allowed to take place, as may quite well occur when steam lanes are formed or when baffles are placed between the tubes, then the evaporation and concentration at these points is more rapid than at some other points and the sugar grains formed will necessarily be uneven in size.

The inclined or conical-shaped calandria makes the process of the discharging of the thick massecuite after concentration quite a simple operation. There are no flat surfaces on which sugar can lie and burn; while the heating surface of the lower portion of the calandria extends into the conical bottom of the pan and helps circulation in it.

The steel wrapper plate we have previously referred to is attached to the flanges of the cast brass tube plates with close pitch riveting, so that the calandria can be

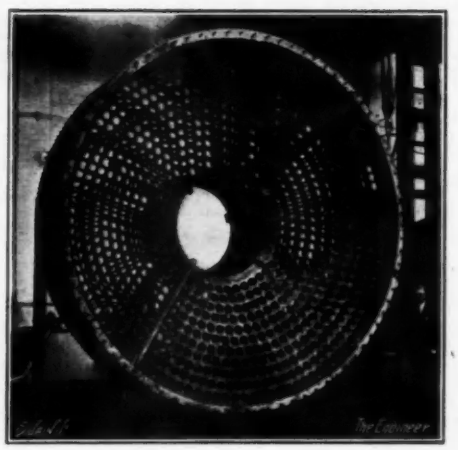


FIG. 3—INCLINED CALANDRIA IN HALVES

designed for considerably higher pressures than could formerly be used with cast iron calandrias. This construction also does away with the difficulty of keeping the calandria steam tight when unequal expansion takes place between the cast iron pan body, which is at a temperature of 120 deg. to 140 deg. Fah., the bronze tube plate, and the cast iron calandria shell, at a temperature from 220 deg. to 240 deg. Fah.

Again, as the heating surface is well distributed to the circumference of the pan, the surface required is obtained with shorter tubes than with the older design in which a calandria of smaller diameter is inserted inside the pan as a separate element. This is an important point, as it enables boiling to be started with a much smaller proportion of liquor in the pan. In a general way, the calandria has to be covered with liquor before boiling is commenced, otherwise the sugar may caramelise or burn on the exposed surfaces. The "grain" or the minute sugar crystals which appear in the supersaturated liquor can be formed with a smaller proportion of liquor and thus, owing to the larger proportion of liquor which can be added to the initial or graining volume, a large size of sugar grain can be built up.

Other advantages of the design we have illustrated include the close grouping of all of the control valves and instruments. These are led to one convenient position in front of the vacuum pan and can be reached by an operator without moving from one place. The inlet or charging valves are connected to an annulus on the bottom of the pan so that an even distribution of the incoming liquor is obtained. Hot water or steam can also be admitted through this annulus for washing or steaming purposes, while the steam inlet and exhaust connections are led to one point and are controlled by one valve on each main. The earlier practice was to fit valves on opposite sides of the pan, which, however, necessitated the pan boiler going from one side of the pan to the other, when starting or stopping it or when changing over from exhaust to live steam. It may be noted from Figs. 1 and 2 that the sight glasses for the observation of the level of the liquid in the pan are arranged in a double row, a system which enables the operator to have the exact level always in view. When a single row only is provided, the level is, of course, lost sight of when passing from one sight-glass to another.

In Fig. 2 we show a 15ft. diameter pan erected in the maker's works at Glasgow, which is for a sugar refinery

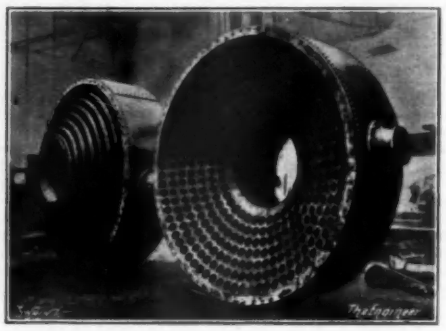


FIG. 4—CALANDRIA HEATING ELEMENTS

in Australia, and Fig. 3 shows the calandria for this pan, which is made in halves. The two views reproduced in Fig. 4 show the design of the calandria heating elements. The tube plates, it will be seen, are so arranged as to have a true conical surface on the upper tube plate, while the pocket for each tube is so shaped that the tube is not cut at the angle of the cone as in some other designs, but is cut square, so that expansion of the tube in the tube plate is a convenient and simple operation.

An 11ft. diameter inclined calandria vacuum pan of the special type which we have described, is now in operation in a beet sugar factory in England, which works as a refinery during that part of the season when the sugar beets are not being sliced. This pan is designed to boil a white syrup of about 65 deg. Brix. The time for one complete strike or cycle is 2 h. 10 min., when the boiling is carried out with exhaust steam at a range of from atmospheric pressure to 10 lb. gauge pressure supplied to the calandria. The vacuum used is 27in. at the commencement of the strike, which is reduced to about 20in. at the finish of the strike, the boiling temperature at the finish of the strike being from 180 deg. to 184 deg. Fah. The massecuite is generally struck at 91·5 deg. Brix. The average rate of evaporation throughout the strike has been calculated to be about 12·7 lb. of water per square foot of heating surface per hour, which may be regarded as an exceptionally high rate when boiling with exhaust steam.

LAUNCHES AND TRIAL TRIPS.

RECORDER, single-screw cargo vessel; built by Cammell Laird and Co., Ltd., to the order of the Charente Steamship Company, Ltd., Liverpool; dimensions, 418ft. 3in. by 54ft. 3½in. by 32ft. 7in.; to carry cargo. Engines, triple-expansion; constructed by the builders; launch, July 29th.

CLAUGHTON, passenger ferry steamer; built by Cammell Laird and Co., Ltd., to the order of the Corporation of Birkenhead. A speed of 12½ knots was attained on trial trip, August 2nd.

HOLMSIDE, steel screw cargo steamer; built by Cowpen Dry Docks and Shipbuilding Company, Ltd., to the order of the Burnett Steamship Company, Ltd.; dimensions, 350ft. 3in. by 48ft.; to carry cargo. Engines, quadruple-expansion; constructed by North-Eastern Marine Engineering Company, Ltd.; trial trip, August 6th.

HAVSTEN, motor-driven tanker; built by Barclay Curle and Co., Ltd., to the order of Messrs. Rafen and Loennechen, of Norway; dimensions, 420ft. by 58ft. 6in. by 31ft. 3in.; to carry oil. Engines, single-screw four-cylinder, two-cycle Barclay Curle-Doxford opposed piston patent airless injection oil engine; constructed by the builders; trial trip, August 12th.

BEAULIEU, single-screw oil tank motor ship; built by Sir W. G. Armstrong Whitworth and Co. (Shipbuilders), Ltd., to the order of Messrs. Biarn Biarnstad and Co., Oslo; dimensions, 408ft. by 54ft. 9in.; to carry 9000 tons. Engines, single-acting, two-cycle, air injection, port scavenging type; constructed by the builders; trial trip, August 16th.

SEA VENTURE, No. 1451, steamship; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of the Diver Navigation Company, Ltd.; dimensions, 305ft. by 43ft. by 20ft. 10in.; to carry 3500 tons. Engines, triple-expansion, 20½in., 33in., 54in. by 36in. stroke; constructed by North-Eastern Marine Engineering Company, Ltd.; launch, August 25th.

ATHELFOAM, single-screw motor tanker; built by Cammell Laird and Co., Ltd., to the order of United Molasses Company, Ltd.; dimensions, 425ft. by 55ft. 9in. by 32ft. 3in.; to carry oil or molasses in bulk. Engines, one set six-cylinder, single-acting, four-cycle, oil engine; constructed by North-Eastern Marine Engineering Company, Ltd.; launch, August 26th.

IN NOMINE DEI, lighter; built by the De Maas Shipbuilding Company; dimensions, 344ft. 6in. by 39ft. 4in. by 9ft.; launch, August 26th.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Birmingham Quarterly Meeting.

THE autumn quarterly meeting of the Midland iron trade, held in Birmingham to-day—Thursday—was of a gloomy character. Industry throughout the kingdom was stated by the various representatives present to be in an unhealthy condition, and signs of re-invigoration are conspicuous by their absence. No one was prepared to forecast the probable course of trade during the remainder of the year, consequently they were unwilling to enter into negotiations covering the current quarter. The business transacted related almost entirely to current, or, at best, early, consumptive requirements, thus showing no change from the methods of trading adopted now for many months past. No change in iron or steel prices, alike finished and raw, is anticipated at the moment, and any future movement would probably be in a downward direction, so that users have a further argument against the advisabilty of buying forward. Raw iron and heavy steel prices are upheld by controls, while values of other materials, though not showing much movement in either one direction or the other, are not firmly established. Competition, both internal and foreign, is very keen, and it is becoming more and more difficult for native producers to meet the latter. The recent collapse in control of prices of continental material has left such a disparity between foreign and home selling prices, that producers here are, in some cases, unable to compete. Fortunately, manufacturers in this district have a good many specialities which are proof against foreign competition, and these are helping to keep the mills going. The quarterly meeting is usually looked to to provide an idea of the probable course of prices and the trend of business over the next three months, but on this occasion it failed to clarify the position, and industrialists left as mystified and cheerless as they arrived.

Raw Iron.

Midland blast-furnacemen are not in the strong position which they occupied in the autumn of last year. Then they had any amount of orders on their books and a ready market for all their production, while prices were steadily advancing. To-day, order books are sparsely filled, demand is poor and even unresponsive to a recent price concession, and, further, production is not being anything like fully taken up and stocks at many of the furnaces, especially in Northamptonshire, are large and constantly growing. The consumptive requirements of the forges and foundries are not what they were and small tonnage orders given out week by week, as the material is required for use, represent the general order of business. Smelters who recently considered the price question were satisfied that further price concessions would prove unavailing in stimulating sales, and, accordingly, they maintained the ruling rates. Although values are down 5s. per ton on the price ruling in October last—the fall having occurred during the past quarter—furnacemen maintain the control of selling rates, the Pig Iron Producers' Association being as strong as ever. There were many merchants and consumers of raw iron who had held that a period such as the one now being experienced by furnacemen would result in a break in the ranks and that complete control of prices would not be possible. So far, however, they have been confounded, for smelters have held together without the slightest sign of a break-away, and the selling rates fixed by the Association are rigidly adhered to. These, at date, are: Northamptonshire forge, £3 5s.; No. 1 foundry, £3 13s.; No. 2, £3 12s.; No. 3, £3 10s.; No. 4, £3 9s.; Derbyshire forge, £3 8s. 6d.; No. 1 foundry, £3 16s. 6d.; No. 2, £3 15s. 6d.; No. 3, £3 13s. 6d.; No. 4, £3 12s. 6d., delivered at stations in the Black Country. Stocks are increasing at most of the furnaces making pig iron in Northamptonshire, though the output is fairly absorbed in Derbyshire, where the demand for cast iron pipes is maintained. Buyers of ordinary foundry qualities are only taking small quantities and cannot be persuaded to consider forward commitments. Their requirements are much below the normal at this period of the year. Forgemen are consuming even less than they were, and there is no indication of any broadening of trade in this branch.

Furnace Coke.

Blast-furnace coke quotations have stiffened on the strength of an expanding export demand, and a concurrent opening out of the market at home for winter fuel for central heating systems. Though the output of coke had been brought within more manageable bounds, the market does not respond to the higher prices. Ovenmen on 'Change in Birmingham this week had to be content with 12s. to 12s. 6d. for blast-furnace contracts.

Staffordshire Iron.

In the Staffordshire finished iron trade there is no improvement on the dull conditions, and ironmasters everywhere are agreed as to the shortage of new business. The volume of orders on ironmasters' books is comparatively light, as it has been during practically the whole of the year, and evidence is lacking of prospects of any general reinforcement of trade vitality during the current quarter. Values are as they stood twelve months ago to-day, with the exception of best grade iron, which is making 10s. more per ton than it did then. The department of the iron trade devoted to the production of marked bars is the only one which has had a really moderate run of business throughout the year. There is always a certain demand for this iron for high-class engineering purposes, and makers have no severe competition with which to contend. They are able to get their full selling price of £12 10s. per ton without difficulty. Next in the scale of activity comes the scrap department. Here business is, and has been, fairly reasonable, and the orders placed at to-day's quarterly meeting were at a figure exactly similar to that ruling at the corresponding meeting twelve months ago, viz., £11 2s. 6d. per ton. Makers of Crown bars are poorly employed. Trade has been almost constantly bad. There have been one or two small buying spurts during the year, but they have been of little moment. Staffordshire-made Crown iron is dearer at £10 7s. 6d. than that produced in other districts, and though it is claimed that it is superior in quality and well worth the extra price asked for it, in these days of stringency it is difficult to persuade consumers that this is so. Though some makers are prepared to sell at 7s. 6d. per ton below the generally recognised price level, they still fail to make sales against their rivals and there are no marked prospects of any change taking place in the position during the remaining three months of the year. As to nut and bolt iron business may safely be reported as stagnant. Continental material suitable for similar purposes is so cheap that local bars are right out of the market. Ironmasters producing this class of material are depressed and discouraged, for they can see no ray of light. The remainder of the year is likely to be for them as unproductive of business as has been the first nine months.

Steel.

The past quarter has not brought any improvement to the steel trade locally; indeed, in some branches it has been considerably shrunk by severe competition from the Continent consequent upon the collapse of price control abroad. This has caused home makers of semis to cut their selling rates, though makers of finished material have been able to hold their ground, probably owing to the workings of the rebate scheme in which so many of the local engineers and merchants are participants. Makers of billets who, three months ago, were asking £6 per ton for their output, are now glad to get £5 15s. Cheaper continental raw material has enabled Staffordshire re-rollers to reduce the selling price of small bars by 7s. 6d. per ton on the quarter. Bars which at Midsummer commanded £8 now sell at £7 12s. 6d. Steel works hereabouts are mostly working short time, and it is very difficult to keep mills running with the small specifications which come in from day to day. On 'Change to-day, it was reported that a few sales of bridge plates and other engineering steel are being made, but generally structural material is in very poor demand. There is a scarcity of building contracts, and some Midland constructional firms state that trade is worse than it has been for years. Moreover, they complain of the very narrow margin of profit shown by to-day's prices for contracts. The question of finished steel prices is likely to be considered when the Steel Association meets at the end of the month. Raw materials have fallen considerably since finished steel quotations were last fixed, and the competition from the Continent is more acute, so that some readjustment is thought probable. Billets and bar mills are getting only meagre orders. Continental material bought a month ago is an obstacle to business in British products. There is no noticeable renewal of transactions in imported steel. Indeed, the market for foreign material is dragging now that consumers have satisfied their requirements for a few weeks ahead. This week continental billets are quoted at £4 10s. for 2in. steel bars, and iron bars can be had for about £5 7s. 6d. delivered, and strip at £6 5s. Midland producers say that it is impossible for them to reduce their quotations further, as they are at the lowest level which production costs will permit.

Galvanised Sheets.

Commenting upon the state of trade in the galvanised sheet industry on the occasion of the autumn quarterly meeting a year ago, I wrote: "No improvement is discernible in the galvanised sheet industry, and market conditions in this department are decidedly slow." To-day's meeting finds a similar state of things ruling, except that whereas a year ago values of 24-gauge stood at £13 7s. 6d. to £13 15s. per ton, to-day, the selling figure is £11 12s. 6d. Millowners on 'Change in Birmingham to-day reported that they are just about able to keep the mills at work chiefly with an irregular inflow of business from home consumers. The export markets are showing very little interest, and shipments are much below those registered a year ago. The orders standing on the books are relatively small and rollers cannot see any distance ahead. They are anxiously awaiting signs of awaking demand in overseas markets. It is reported here that price restrictions no longer apply to the galvanised sheet trade with India. Little of this passes through the hands of Birmingham merchants, however. The past quarter has been a poor one and the outlook for the current three months is far from bright.

Scrap.

The market for steel scrap is lifeless, as consumption at steel works is of necessity considerably reduced. Even where contracts are on hand it is difficult to get steel works to take delivery. It is not possible to quote a market price owing to the small amount of business passing.

90-ton Wagons for India.

There are to be built at the Washwood Heath works, Birmingham, of the Metropolitan-Cammell Carriage Wagon and Finance Company, Ltd., eighty hopper wagons for service on the Bengal-Nagpur Railway, India. They are of a special type and are intended for the carriage of iron ore, for which they have a capacity of no less than 63 tons. The weight of each wagon—unloaded—is 27 tons, thus making the total weight on rails 90 tons. The vehicles are of all-steel construction, fitted with both vacuum and hand-operated brakes, and the door mechanism is so arranged that the load may be discharged from the bottom doors, either centrally, at either side, or on both sides simultaneously. Forty of the wagons are to be equipped with specially designed bogies of the diamond frame type with cast steel bolsters, while the remaining forty wagons will have bogies of the Sheffield-Twinberrow patented type, two of these being fitted for experimental purposes with S.K.F. roller-bearing axle-boxes.

Cannock Chase Coal Profit.

A profit of 1·73d. per ton was made during August on all the coal raised in the Cannock Chase and Pelsall coalfield. This is an improvement on the position in the last four or five months, during which successive losses have been suffered. In July, there was a loss of 10·98d., and in June of 2s. 2·22d. a ton. Miners' wages for October, which are based on the ascertainment for the months of June, July and August, remain at the minimum rate of 42 per cent. on the 1911 basis, but the industry's ability to pay is only 11·50 per cent. A stallman's minimum wage is 9s. 6d. a shift, a loader's 8s. 6d., and an able-bodied surface worker's 6s. 8d. There is an accumulated deficit due to the colliery owners, under the agreement, of £4,047,592, but this figure is officially stated to be subject to essential deductions, which reduce the total to only one-third of the sum mentioned. The increase of the deficit last month amounted to £40,749.

Copper Works to Close.

It was stated on Saturday that in consequence of the decision of Walsall Town Council to take action with regard to the alleged emission of noxious fumes, the furnaces of the James Bridge Copper Works are to be closed down for an indefinite period. About one hundred and fifty men will lose their employment in consequence.

The Midland Colliery Explosion.

The disaster at the Grove Colliery, Norton Canes, is one of the worst and, apparently, one of the most unaccountable in the history of the Cannock Chase coalfield. What caused the explosion is a mystery. The men were not engaged in coal-getting, but in moving an electrically operated cutter into position for the night shift. The current is stated to have been disconnected, and up to the time of writing there seems to be no substantial basis for any theory as to the cause of the explosion, which resulted in the death of every man of the shift engaged in that part of the workings.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Electricity and Other Grants.

FINANCIAL help for electricity schemes in Lancashire and Cheshire figures prominently in recent decisions of the Unemployment Grants Committee. The most important concerns the change over of electricity supply at Preston, and towards the cost of this a grant of £141,000 has been made to the Town Council. A grant of £25,059 has been made to Lancaster Town Council for sub-station extensions, and among minor grants is one of £6871 to Rawtenstall Corporation for cable laying. Colne Town Council is to receive £30,000 towards the cost of a vertical retort installation scheme, whilst in Cheshire a grant of £31,100 is being made to the Alderley Edge and Wilmslow Electricity Board for electricity mains, and one of £55,762 to Chester Town Council for sewage works. A number of smaller grants to authorities in the Lancashire and Cheshire areas for road construction and widening and other schemes are recorded.

The Heavy-oil Engined Omnibus.

A great future for the heavy-oil engine for road transport purposes was forecast by the Chairman of the Corporation Transport Committee (Councillor Brassington) at the last meeting of the Manchester City Council. Some discussion arose as to the intentions of the Committee following upon the proposal to abandon the use of electric tramcars on the important route from Manchester to Altrincham. The view of the Electricity Committee is that unless the City Council is perfectly satisfied that the overhead trackless tram is not as suitable, the substitution of motor omnibuses for electric tramcars ought not to be sanctioned. The Chairman of the Transport Committee expressed the view that in a very short time the heavy-oil engine would sound the knell of both the tramcar and the petrol-driven motor omnibus. He had little hope of the Committee being satisfied with the trackless tram system. Personally, he had been favourably impressed with the results obtained at Leeds with an omnibus fitted with a heavy-oil engine.

Loom Works to Close.

The announcement has been made during the past few days that William Smith and Brothers, Ltd., of the Sun Ironworks, Heywood, near Manchester, has decided, for reasons of trade depression, to close the works down for an indefinite period when the orders in hand have been completed. This is expected to be about the end of the present month. The firm is well known in Lancashire as makers of power looms and of preparation machinery for the textile industry, the works having been established as far back as 1824. During the last year or two, short-time operations have necessitated the employment of only about a hundred men, although normally work was provided for between three and four hundred.

Personal.

Mr. J. S. Nuttall, who has just completed fifty years' association with Platt Brothers and Co., Ltd., textile machinery manufacturers, of Oldham, and who, until about three months ago, was chairman of the board of directors, has, owing to advancing years, resigned his seat on the board.

Non-ferrous Metals.

Except that copper on balance is a few shillings better than it was a week ago, the past week has witnessed another disastrous spell for the non-ferrous metals markets. A fair degree of activity has been experienced in the tin section, with, however, much of the buying of a speculative character. The further loss of about £3 a ton, following upon the previous week's fall of £7, well illustrates the weak state of the market, this notwithstanding the recent improvement in the statistical position, the visible supply

of the metal having shown a rather substantial decline. Both standard and refined descriptions of copper continue to meet with a poor demand from consumers here, and the market has been a fluctuating one during the past week, with, however, a net improvement compared with a week ago of roughly 7s. 6d. a ton for standard brands. A fresh relapse has occurred in the case of spelter, and only a relatively quiet trade is being done. Statisticians are going back to nearly fifty years to find prices parallel with those now ruling. The heaviest loss during the week in relation to price has been in the lead section, which, until recently, was successful in putting up a stiff resistance to the declining movement, the drop of 15s. a ton in English metal bringing current values to £2 below what they were at the middle of last month, just before the weak spell set in.

Iron and Steel.

Demand for pig iron here this week has been almost wholly for small lots for early delivery, and although some improvement in foundry trade conditions in Lancashire is looked for, little practical indication of it at the moment is to be found. For delivery in the Manchester district, Derbyshire and Staffordshire foundry irons are quoted at 72s. per ton, forge iron at 67s., Scottish No. 3 at 92s. 6d., and hematite at about 85s. Trade in finished iron is quiet, with Lancashire Crown bars at £10 5s. per ton, and seconds at £8 15s. Conditions in the steel market here are very depressing, and contract specifications are disappointingly small, with very few actual new orders being placed just now. Locomotive engineers, constructional firms, boilermakers and almost every branch of engineering in the district, with only a few exceptions, are poorly placed. Re-rollers are now offering small bars at from £7 10s. to £7 12s. 6d. per ton, with boiler plates down to £9 10s. Sections are maintained at £8 7s. 6d., joists at £8 10s., tank plates at £8 17s. 6d., and large bars at £9 7s. 6d. per ton.

Death of Mr. P. F. Crinks.

The death is announced of Mr. P. F. Crinks, who was for many years with the Metropolitan-Vickers Electrical Company, Ltd. Mr. Crinks was a pupil of Mr. H. Faraday Proctor, and later held several appointments on the engineering staff of the Bristol Corporation electricity department. He joined the British Westinghouse Electric and Manufacturing Company in 1910, and for several years represented it in the western circuit. After being transferred to the London office of the company, he was appointed London sales manager, and later managing director of Metro-Vick Supplies, Ltd. Mr. Crinks was a prominent member of the E.L.M.A. and E.D.A. Councils.

Barrow-in-Furness.

Hematite.

The fact that the steel trade is at a very low ebb at present makes the iron trade very quiet. If the two steel works were engaged at present on railway material, the local consumtpion of iron would be considerable, and that would ease the position very much. As it is, with the mills stopped, stocks have naturally increased, for there is not the market for the iron produced from the nine furnaces which are now in blast. Restriction has started and in works where two furnaces are working there are alternate blasts. This practice is reducing production, but at the same time keeping the furnaces in, and thus avoiding the putting out of one and the consequent expense in restarting later. The pig iron trade is still dull, but there is a faint ray of hope in the shape of more inquiries. In the meantime customers are keeping down their orders to the lowest. Continental business has not much life in it, and American orders are not heavy by any means. A part cargo was dispatched to Philadelphia last week. Stocks exist at present, and the demand at present will not reduce them. Iron ore, both native and foreign, is in quiet demand. The steel trade is very dull and both Barrow and Workington mills are idle, but there is a possibility of Workington going on for a week on rails for South America and elsewhere.

SHEFFIELD.

(From our own Correspondent.)

The Production of Steel.

The output of steel by the open-hearth process continues at a low level, both in this immediate district and in North Lincolnshire. The orders coming to hand, although fairly numerous, are generally for small quantities, and of an unremunerative character. There is practically no bulk buying, and little business of a forward kind. No changes are reported in the controlled prices of iron and steel material. The official returns of production for August show how serious was the falling off in that month as compared with July, which in itself was a poor month. The ingots and castings turned out in Sheffield and district in August, in fact, established a new low record, being only 63,500 tons as compared with 82,200 tons in July and 113,400 tons in August last year. The total included 29,100 tons of acid and 28,100 tons of basic steel. In Lincolnshire the fall was equally marked, as the 36,900 tons of August had to be set against the 63,200 tons of July and the 56,900 tons of August, 1929. The pig iron production in Lincolnshire during August was 56,200 tons, as against 59,100 tons in July and 79,900 tons in August last year. All this iron was a basic quality. Present conditions show no improvement on this standard. A blast-furnace in Lincolnshire has just been damped down and steel melting in the Sheffield district is being further reduced.

At Vickers' and Browns'.

The best employed establishment in Sheffield at present is the Vickers Works of the English Steel Corporation. This firm is interested in a wide variety of products, and is busy in some departments, but not all. Employment is being found for about 6000 persons. It is interesting to know that Sheffield is to have an important share in the building of the great new Cunard liner, which John Brown and Co., Ltd., are shortly about to lay down at their Clydebank shipyard. The work to be done at their Atlas Works, Sheffield, will include the making of the very large forgings required for the turbines of the vessel.

Railway and Other Work.

Although the home railway companies are compelled to observe strict economy in consequence of falling traffics, they are ordering steel material a little more freely just now, their policy being to give out all the work they possibly can in order to help the big steel firms to keep their plants going. There is, accordingly, a rather better tone in the axle, tire, and spring departments. They are not by any means well employed, however, and could do with much more work, especially from overseas. There has been a further decline in work from the shipyards, and prospects from those directions are not encouraging. The steel foundries are not doing well, and there have been some discharges of men from them during the past week. It is not easy to find a firm with a moderately good order book, and confidence in an early revival is not very strong. Some of the busiest departments are those engaged in special trades, like the production of requirements for the automobile industry, stainless and non-corrodible steels, but they are considerably below the best. The demand for cold-rolled steel fell off substantially a while ago, and has not recovered much of its lost ground.

The Scrap Trade.

The steel scrap merchants have no cheering news to report, as the demand continues low in spite of the fall in prices. This fall was referred to by the chairman of Thos. W. Ward, Ltd., at the company's annual meeting last week, as "appalling." Although the firm's tonnage turnover, for the twelve months ending June last, showed an increase of 95,865 tons on the preceding year, the value was £134,691 less. Mr. Ward pointed out that the exports of scrap have fallen materially, and very little is being shipped abroad to-day. The export figures for the twelve months were 266,009 tons, as against 402,317 tons for the preceding year, while the imports during the same period increased from 49,275 tons to 168,478 tons. Mr. Ward advocated that the dismantling of obsolete British ships should be kept in British yards, but said that in order to do that it would be necessary, at periods when foreign competition for the ships is keen, for some subsidy to be made to British owners for the loss they would incur by dismantling in this country.

Material for the "R 101."

Sheffield and Rotherham have a melancholy interest in the disaster which has befallen the "R 101," for they played a large part in its construction. The rustless steel strip used in the framework of the great airship was manufactured in Sheffield, and rolled by J. J. Habershon and Sons, Ltd., of Rotherham. It is interesting to recall a statement which appeared in Messrs. Habershon's works magazine for August, showing the extreme care which was taken with the material: "When we were first approached with regard to rolling strip for the 'R 101,'" they said, "the constructors, Boulton and Paul, Ltd., and the Air Ministry were almost at their wits' end, for months of experiments and endeavours to obtain suitable strip had resulted in failure. When it is realised that the steel has to give a proof stress of 65 to 75 tons, and at the same time to stand a transverse bend equal to a radius of three times its own thickness, the difficulties will be appreciated. This entailed the testing of every coil of steel before the Air Ministry would pass it; the product of every heat of annealing had to be tested, and every coil had to be subjected to the bend test before leaving our works. In addition to these physical tests, the surface of every inch of strip was carefully scrutinised before leaving these works, and the slightest mark or scratch caused rejection. Needless to say, the same careful testing took place at the works of the constructors on receipt of the strip from us, before they used the material. Notwithstanding the exacting nature of the requirements, we succeeded in delivering the goods, and we have supplied upwards of 20 tons of perfect strip for the 'R 101,' all of which met the requirements of the Air Ministry's specifications."

New Pipe Foundry at Staveley.

Some interesting information is now available with regard to the new foundry which, as previously reported, the Staveley Coal and Iron Company, Ltd., is installing for the purpose of making cast iron pipes by a new centrifugal process under patent rights acquired from the Sand Spun Patents Corporation of America. The foundry will be unique in this country, and there are at present only three plants in operation in the world—two in America and one in Canada—while one is in course of erection on the Continent. The manager of the new foundry has spent a considerable time in investigating the details of the American plants. The main building at Staveley, which is now nearing completion, is 420ft. long, 200ft. wide, and about 72ft. high. Alongside the main building three cupolas are being built, and there is to be a laboratory attached to the plant for testing and controlling the iron, sand, and other materials. Pipes are to be cast in 4in., 6in., 8in., 10in., and 12in. sizes, of the socket and spigot type, in 16ft. lengths.

A Stainless Steel Vane.

A weather vane of Sheffield stainless steel, which was fixed at the top of a 200ft. high church steeple in Sheffield five years ago, in place of an iron one which had become badly corroded, has just been inspected by the steeplejack who placed it there, and found in good condition. He reports that, with the exception of a deposit of Sheffield "muck," the surface shows not the slightest trace of deterioration. The examination also yielded evidence of the conductivity of the stainless steel in conjunction with the lightning conductor attached to it. The combination is declared to have proved highly efficient.

The Lighter Trades.

There was an increased output of cutlery, spoons and forks during September. There is no improvement to report, however, in sterling silver and plated hollow-ware. Trade with overseas markets, particularly Australia, is on a very restricted scale.

NORTH OF ENGLAND.

(From our own Correspondent.)

Dismal Iron Trade Outlook.

The outlook in the Cleveland pig iron trade is as dismal as it can be. Normally, at this period of the year, orders should be coming to hand regularly, but, instead, there is a state of contraction which is alarming, and there is every prospect of a still further reduction in output. There is not the least sign of confidence. The exports of iron and steel from the Cleveland district last month were the smallest for any month this year—smaller, even, than August, the recognised holiday month. For the past three months the exports were as follow:—July, 71,345 tons; August, 63,039 tons; September, 57,526 tons. Coastwise shipments of pig iron actually increased from 6978 tons in August to 9233 tons in September, but exports of pig iron to foreign ports fell in the same period from 9885 tons to 4897 tons, and manufactured iron and steel shipments fell from 46,176 tons to 43,396 tons. Foreign iron is coming into the Cleveland district in increasing quantity, and whilst the majority of local consumers prefer local iron, their purchases are chiefly limited to small parcels for early delivery. Export business has almost ceased, and the limited demand all round holds out no promise of any expansion in the output. Cleveland prices are much above continental quotations, but they are kept unchanged, No. 1 foundry being 66s., No. 3 G.M.B. 63s. 6d., No. 4 foundry 62s. 6d., and No. 4 forge 62s.

Hematite Pig Iron.

The tone in the East Coast hematite pig iron trade is less cheerless than in some branches of the staple industry. Restricted production is inadequte to moderate needs, but withdrawals from the heavy stocks are not large. Further sales by makers and merchants include parcels for dispatch to foreign destinations, and values seem more likely to advance than otherwise. The difference between hematite and Cleveland pig iron prices is about the same as ruled in normal pre-war days. Mixed numbers are selling at 71s., and No. 1 is realising 71s. 6d.

Ironmaking Materials.

Foreign ore is very slow of sale. Consumers are well placed as regards supplies and are off the market. Best Rubio ore is nominal at 18s. c.i.f. Tees. Sellers of blast-furnace coke experience difficulty in arranging contracts, but are not disposed to make price concessions. For early delivery of good average kinds delivered at North-East Coast works 17s. is named, and for supply over periods to the end of the year 17s. 6d. and upwards is asked.

Manufactured Iron and Steel.

Scarcity of orders for manufactured iron and steel is as acute as ever. Departments producing railway material and constructional steel are better employed than are manufacturers of several other commodities, but in all branches work is needed. Prices are unaltered.

Iron and Steel Imports.

Although more iron and steel was brought into the River Tees last month than in any of the five preceding months, the tonnage was considerably less than for the corresponding month last year. The total tonnage of the iron and steel imported into the Tees for the eleven months ended September 30th is also less than for the corresponding period, twelve months ago. Only 1263 tons of pig iron was imported in September, as against 2354 tons in September last year. The pig iron imported during the eleven months ended September 30th was 11,668, compared with 28,263 tons for the corresponding period a year ago. The comparative figures for the importation of iron and steel during this period was 137,008 this year, as against 174,929 tons last year. Last month, 13,929 tons were brought into the Tees.

Ironworkers' Wages Reduced.

The average net selling price of No. 3 Cleveland pig iron during the past quarter has been certified as 62s. 3·65d. per ton. Under the sliding scale arrangement, this means a reduction in the wages of blast-furnacemen employed at North-East Coast works of 3·50 per cent., which will bring down the wages from 11·75 per cent. above the standard to 8·25 above the standard.

Colliery Contrasts.

There is no change in the Northern coal trade position, and demand still falls short of supply. Yet individual conditions with different companies are in sharp contrast. In one district pits have had to be closed, and in the others there is increase of output in contemplation by the opening out of old workings, as, for example, at Newsham, near Blyth. There are undertakings which have scarcely lost a day this year, bad as trade is; but, of course, with the majority the experience has been just the reverse, lost time having been almost a weekly occurrence. These extremely varying circumstances show how difficult it may be to work the new Mines Act, with its minimum prices and quotas of production. With some pits the imposition of a quota of production would put them out of their regular stride, as it were, and involve them in loss, while, as to minimum prices, there are collieries able to pay their way at prices which would cause a loss to some of their neighbours. Moreover, they all have to export,

and the foreigner is not concerned with minimum prices so long as he has plenty of alternative coals to choose from. In this connection the favourable cards are in his hands just now.

Coal Trade Prices.

The October coal trade outlook points to a continuance of recent easy conditions for all classes of coal. For Northumberland steam coal the position is just quietly steady. Best screened are plentiful, but held fully at 13s. 6d. direct and at 3d. to 4½d. concessions through contractors. Stocks of small are ample, but quotations are unchanged at 10s. Durham steams are moving under slow conditions, and are freely offered at 14s. 9d. for best and 12s. for small. Tyne primes stand at 12s. 9d. and 10s. 6d. and other grades at 12s. 9d. and 9s. 6d., large and small respectively. With consumers holding off the markets, and the large gasworks taking out minimum contract quantities, all descriptions of gas coal are difficult to clear. Holders, however, hold steadily against making any concessions. Best qualities are at 15s., and secondary sorts, despite ample stocks, hold for a full minimum of 12s. 6d. Coking unscreened supplies are more than required, and quotations are nominal at 12s. 6d. to 12s. 9d. For bunker purposes the demand is light and stocks are heavy. Secondary qualities offer at 12s. 6d. and superiors at 13s. 6d. The demand for foundry coke classes remains very poor, and stocks are steadily increasing. Values are weakly held for prompt at 17s. to 17s. 6d., but steadier forward at about 6d. higher. Beehive and special class foundry coke is quietly steady at 24s. to 28s. Gas coke is in good request and stocks remain at a low level. Makers ask 21s. firmly for best qualities.

SCOTLAND.

(From our own Correspondent.)

Better Inquiry.

DURING the past week or two there has been a better inquiry for steel and iron, and it is confidently expected that before long business may show some improvement. Continental weakness has had a considerable effect on the position here, consequently the efforts being made to prevent a further weakening and to establish a firmer basis on the Continent is regarded as a more hopeful sign. Already there are evidences of renewed activities in certain districts, which may eventually spread to other communities.

Steel.

So far as heavy steel is concerned, the position shows no improvement. Specifications are very scarce, and makers experience a considerable amount of broken time, more especially those interested in shipbuilding material. Specifications for export material, too, are very scarce. Recent reductions in export prices have not yet proved beneficial to sheet makers. Ordinary black sheets are not particularly well specified and galvanised descriptions are neglected. Tube makers are having a very quiet time in all branches.

Iron.

Reports from makers of bar iron and re-rolled steel indicate a continued scarcity of specifications, and a very low level of prices for export. Re-rolled steel bars are quoted £7 12s. 6d. per ton, home or export, but lower terms may be obtained for export. Lack of demand for local consumption and large importations from India, the Continent and elsewhere account for the poor position and outlook in the Scottish pig iron trade. Outputs are very restricted and there is little hope of any additional furnaces being put into blast for some time to come.

Scrap.

Dealings in scrap are still on a hand-to-mouth basis, and prices show little or no change, with cast iron machinery about 61s. 3d. and heavy steel 52s. 6d. per ton.

Coal.

The coal trade in Scotland does not show the signs of development usual at this season of the year. Home demands are slow to increase, and the collieries find difficulty in securing the usual seasonal increases in price. Keen continental competition continues to place a barrier to certain foreign markets. Exporters are doing little more than a day-to-day business of restricted volume, practically nothing of a forward nature being entertained. Exporters, of course, are handicapped by the uncertainty existing as to the effect of the Coal Mines Act and colliery schemes on prices, and are really not in a position to quote terms likely to prove effective in competition with continental fuel. Apart from Lanarkshire splints and ells, which have a fairly steady outlet and are restricted in the quantities available, all large fuels are inactive and weak. The larger sizes of nuts are moving freely, but small nuts are not particularly well placed. Aggregate shipments amounted to 202,277 tons, against 231,691 in the preceding week and 267,947 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

The Coal Trade.

THERE has been no improvement in the steam coal section of the industry during the past week, though anthracite coals are firm and shipments comparatively active. The last shipments for Montreal and Quebec are now being made, as tonnage will not go out to the St. Lawrence after this month, which means that an outlet for anthracite elsewhere must be found when the Canadian season closes. Still, it must be admitted that the returns of shipments of steam and anthracite coals last week as issued by the Great Western Railway Company were very disappointing, as the total only came to 493,400 tons, which compared with 535,100 tons in the preceding week, and with 580,345 tons for the corresponding period of last year. There was, in fact, no real loading pressure, and even the berths which the G.W.R. Company ultimately agreed to keep open at the Bute East Dock under the pressure of the traders, were far from being fully occupied, which must, of course, be disappointing to the company. On Friday last the position at the whole of the docks was that eighteen tipping appliances were idle with five vessels waiting to load, but on the Saturday the number of idle tips was increased to thirty-eight. Six steamers which were waiting were at Swansea where the bulk of anthracite coals is shipped. Arrivals of tonnage over the week-end brought the number of idle tips down to twenty-three and four steamers were waiting at Swansea; but although the chartering of tonnage has been slightly more active of late, it is to be feared that the extent of this activity has not been such as to create any material change in the general situation. Numerous collieries are working short time, and the amount of new business on the market for prompt loading is extremely limited, while there is nothing fresh of importance to record so far as contract operations are concerned. It is reported that the contract for the Port Sudan Railways for 50,000 tons has been secured for Natal coals, but this was not unexpected.

Coal Negotiations.

The attitude of the Mining Association towards the National Industrial Board and the declaration of the President of the Mining Association that questions affecting wages and working conditions must be dealt with by the districts separately came as no surprise in South Wales. It is, of course, early yet to say what may come of the negotiations proceeding here for a new wages agreement, but meetings of the joint committee of owners and workmen's representatives have taken place, and although no official report of the proceedings has been issued, inquiries go to show that no headway has been made. The actual claims put forward by the respective sides have also not been made known, but it is understood that the workmen's leaders are adopting a firm attitude, doubtless in the belief that the Government support they will receive will obtain for them all they want.

Coal Loading Shifts.

Reference was made last week to the fact that the tippers had given notice to the Great Western Railway Company of their intention to depart from the existing system of working and to revert as from Monday last to the system of two continuous shifts. Negotiations took place with the company, but no statement was forthcoming as to the progress made. However, last week-end the men agreed to the recommendation of their leaders that the notices should be suspended on the assurance of the head office officials of the N.U.R., of their determination to press for an early joint conference to deal with the men's demand, while, further, the deputation which is to wait on the management with the object of bringing about the re-establishment of the whole of the coal-loading appliances at the Bute East Dock, Cardiff, was instructed to deal with the question of the seniority of the men dismissed.

Tonnage Laid Up.

Returns of idle tonnage officially issued for the ports in South Wales show a fairly substantial decrease. On April 1st last there were eighty-six vessels of 181,426 net register tons laid up. On July 1st these figures were reduced to sixty-nine vessels of 179,195 net register tons, while the figures have now been given for the position on October 1st. These show that the number of vessels was forty-three of 103,051 tons net register, the whole of the vessels being of British registry with the exception of two, totalling 1580 tons net register.

The Fate of Dowlais (Merthyr) Works.

The notices served upon the workmen, numbering about 2500, employed at the Dowlais (Merthyr) Iron and Steel Works expire this week, and the works are to close. The official announcement was forthcoming from Sir John Beale, the chairman of the British (Guest, Keen, Baldwins) Iron and Steel Company, Ltd., in a letter to the Mayor of Merthyr, replying to a request from the Merthyr Corporation for a deputation to see the company. The request came before a meeting of the directors of the company on Monday, and their decision was in the hands of the Mayor of Merthyr on Tuesday. Any idea on the part of the Corporation that the works might not be closed down is dispelled by the letter of the chairman of the company, who, referring to the unfortunate and even tragic decision, says: "The plain fact is that the product of the Dowlais Works cannot now be sold to pay for the cost of operating the works. All that will be left of the once-prosperous South Wales heavy iron and steel trade when work at Dowlais ceases is one blast-furnace operating at Cardiff and one blast-furnace at Port Talbot. It is not even possible to sell the whole product of these two furnaces, either as pig iron or steel, and part of their production of pig iron has now to be put into stock. Unless conditions change, the time must come when one or both of these furnaces will have to be closed down like the Dowlais Works." Of course, the whole of the Merthyr district will suffer considerably by the closing of the works. It will mean the loss of approximately £20,000 per annum in rates and more than £5600 will be lost weekly in wages to the workmen. The working of collieries will be jeopardised, and the working of the Llanharry iron ore mines will be interrupted. The permanent closing of the Dowlais Works would be a somewhat serious matter for the Great Western Railway Company, as the loss of traffic in the course of a year would mean thousands of pounds to the company. The fear that the shutting down of the works now will be permanent is not unjustified. There is a significant sentence in the letter of Sir John Beale, in which he says: "To meet modern conditions, the modernised works must operate on the seaboard, so as to cut out the heavy transport charges which have been such a handicap to Dowlais for many years past. We have, of course, known for a long while that the change to the seaboard was inevitable, but we had hoped that it might have been effected gradually, so as to minimise to the greatest extent the resultant hardship to individuals and to the district, but facts have been too strong for us. The nation has adhered to its old policy too long." While on the subject of iron and steel works, it may be mentioned that the urban authorities have appointed a deputation, representative of all interests, to wait upon the Ebbw Vale Company in order to see if the Ebbw Vale Iron and Steel Works cannot be restarted.

Current Business.

The steam coal market displays no new feature, and is quiet in all departments, except that sized coals are steady. All other descriptions are offered freely and are at the minima. Coke and patent fuel remain without alteration, and pitwood continues rather inactive at 24s. 6d. to 25s.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

GEORGE ELLISON, Ltd., of Perry Bar, Birmingham, asks us to announce that its South African business is being dealt with by George Ellison (S.A.), Ltd., at North British Buildings, Commissioner-street, Johannesburg.

DAVID BROWN AND SONS (HUDDERSFIELD), Ltd., of Park Works, Lockwood, Huddersfield, ask us to announce that an amalgamation has been effected between their company and P. R. Jackson and Co., Ltd., of Salford.

MESSRS. SNELLING AND EDLESTON, consulting engineers, ask us to announce that they have opened offices at Gower Chambers, Gower-street, Swansea, having terminated their active services with the Mond Nickel Company, Ltd., Clydach.

METROPOLITAN-VICKERS ELECTRICAL COMPANY, Ltd., asks us to announce that the address of its Bristol office has been changed to 22, Victoria-street, Bristol. Telephone No.: 6880/1. Telegraphic address: "Multiphase, Bristol." Its Cosmos lamp Depôt will also be at the same address.

THE HUNSLET ENGINE COMPANY, Ltd., of Hunslet Engine Works, Leeds, asks us to announce that it has purchased the goodwill of Kerr, Stuart and Co., Ltd., locomotive engine builders, of Stoke-on-Trent, and that it is now in a position to supply all requirements for that company's types of locomotives.

MR. HERBERT MORRISON, Minister of Transport, has appointed Mr. Aubrey Clark to be his private secretary in place of Mr. G. F. Stedman, who has been promoted, and Lord Ponsonby, Parliamentary Secretary to the Minister of Transport, has appointed Mr. S. S. Wilson to be his private secretary in place of Mr. Aubrey Clark.

BURTON, GRIFFITHS AND CO., Ltd., one of the B.S.A. group of companies, which recently moved its headquarters to Sparkbrook, Birmingham, ask us to announce, in view of the rumour that they have left London, that they have not done so, and that their establishment at 64–70, Vauxhall Bridge-road, S.W. 1, is still being carried on as hitherto.

THE COUNTY OF LONDON ELECTRIC SUPPLY COMPANY, Ltd., asks us to announce—with reference to a statement which recently appeared in the Press, to the effect that the order for 150,000 kilowatts of plant with which it proposes to extend its Barking Power House, "will certainly stay in this country, and is likely to be placed on the North-East Coast"—that that statement is entirely without foundation. Following its usual policy, the Company will, when the time comes, place the order with the firm that submits the tender most suitable for the requirements of the Power Station.

CONTRACTS.

UNITED WATER SOFTENERS, Ltd., of Aldwych House, London, W.C. 2, have recently received from thirty-five separate customers orders for water treatment plants of various types, ranging in capacity from 7500 to 480,000 gallons per day, and with a combined daily capacity of upwards of 2½ million gallons.

THE BRITISH THOMSON-HOUSTON COMPANY, Ltd., of Rugby, has received an order for 160 control equipments for new motor and trailer cars of the London Electric Railways. All the latest improvements are to be embodied in the design of the new equipments, which include circuit breakers, reversers, master controllers, cut-out switches, contactor control gear, relays, switchboards, &c.

LA SOCIETE D'EXPLOITATION DES PROCEDES DABEG has received from the Compagnie Internationale des Wagons-Lits an order for a further number of Dabeg patented automatic slack adjusters for vehicles equipped with continuous brakes, the present order bringing the number of these appliances supplied to the Wagons-Lits Co. up to over 200. The same company has also received from the Paris Métropolitain Railway an order for sixty similar adjusters.

THE MARCONI WIRELESS TELEGRAPH COMPANY, Ltd., has received from the Irish Free State Authorities an order for the supply of a high-power broadcasting transmitter which will be erected in a central position in the Irish Free State to serve the whole of the State. The transmitter, which will embody the latest improvements of broadcasting technique, will have an aerial energy of 60 kW and will therefore be one of the most powerful broadcast transmitters in Europe. It is expected that the new station will be ready to begin operations in the autumn of 1931.

THE METROPOLITAN-VICKERS ELECTRICAL COMPANY, Ltd., has received from the Southern Railway an order for the supply of complete electrical equipments, including the necessary motors, control gear, lighting, heating and compressor apparatus, for 104 motor coaches and 104 trailer coaches. The greater part of the apparatus is for the new rolling stock to be used on the forthcoming electrified service to Brighton. The apparatus for this service comprises electrical equipments for forty-four coach train units, each unit consisting of two motor coaches and two trailer coaches. The remainder of the apparatus is for general extension to the rolling stock of the electrified system and comprise electrical equipments for twelve three-coach train units and six two-coach trailer units. The three-coach train units each consist of two motor coaches with a trailer coach between.

INSTITUTE OF MARINE ENGINEERS: ANNUAL DINNER.—Owing to the President's impending absence in South Africa, it has been necessary to postpone the annual dinner of the Institute of Marine Engineers from the date previously announced—March 16th—to Friday, April 17th, 1931, at the Connaught Rooms, Great Queen-street, London.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
(1) Native	17/9 to 20/6
(1) Spanish	20/6 to 21/–
N.E. Coast—	
Native	18/– to 21/–
Foreign (c.i.f.)	18/–

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(3) Scotland—		
Hematite	3 17 0	—
No. 1 Foundry	3 19 0	—
No. 3 Foundry	3 16 6	—
N.E. Coast—		
Hematite Mixed Nos.	3 11 0	3 11 0
No. 1	3 11 6	3 11 6
Cleveland—		
No. 1	3 6 0	3 6 0
Siliceous Iron	3 6 0	3 6 0
No. 3 G.M.B.	3 3 6	3 3 6
No. 4 Foundry	3 2 6	3 2 6
No. 4 Forge	3 2 0	3 2 0
Mottled	3 1 6	3 1 6
White	3 1 6	3 1 6
Midlands—		
(c) Staffs.—	(*Delivered to Station.*)	
All-mine (Cold Blast)	—	—
North Staffs. Forge	3 8 6	—
,, ,, Foundry	3 13 6	—
(c) Northampton—		
Foundry No. 3	3 10 0	—
Forge	3 5 0	—
Derbyshire—		
No. 3 Foundry	3 13 6	—
Forge	3 8 6	—
(3) Lincolnshire—		
No. 3 Foundry	—	—
No. 4 Forge	—	—
Basic	—	—
(4) N.W. Coast—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 3 6 (*a*) / 4 5 6 (*b*) / 4 10 6 (*c*)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	10 5 0	9 15 0
Best	—	—
N.E. Coast—		
Iron Rivets	11 10 0	—
Common Bars	10 15 0	—
Best Bars	11 5 0	—
Double Best Bars	11 15 0	—
Treble Best Bars	12 5 0	—
Lancs.—		
Crown Bars	10 5 0	—
Second Quality Bars	8 15 0	—
Hoops	13 0 0	—
S. Yorks.—		
Crown Bars	10 5 0	—
Best Bars	11 0 0	—
Hoops	12 0 0	—
Midlands—		
Crown Bars	10 0 0 to 10 7 6	—
Marked Bars (Staffs.)	12 10 0	—
Nut and Bolt Bars	9 0 0 to 9 5 0	—
Gas Tube Strip	11 2 6	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates (Marine)	10 10 0	10 10 0
,, ,, (Land)	10 0 0	10 0 0
Ship Plates, ¼in. and up	8 15 0	7 15 0
Sections	8 7 6	7 7 6
Steel Sheets, ¼in.	8 15 0	8 15 0
Sheets (Gal. Cor. 24 B.G.)	11 17 6	11 12 6

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	8 15 0	7 15 0
Angles	8 7 6	7 7 6
Boiler Plates (Marine)	10 10 0	—
,, ,, (Land)	10 0 0	—
Joists	8 10 0	7 7 6
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	8 2 6	—
Soft Billets	6 17 6	—
N.W. Coast—		
Barrow—		
Heavy Rails	8 10 0	—
Light Rails	8 15 0 to 9 0 0	—
Billets	6 15 0 to 9 10 0	—
Manchester—		
Bars (Round)	9 7 6	—
,, (Small Round)	7 12 6	—
Hoops (Baling)	10 0 0	9 15 0
,, (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
,, (Lancs. Boiler)	9 10 0	—
Sheffield—		
Siemens Acid Billets	9 10 0 (basis)	
Hard Basic	9 2 6 and 9 12 6	
Intermediate Basic	7 12 6 and 8 2 6	
Soft Basic	6 10 0	
Hoops	10 5 0	
Soft Wire Rods	8 0 0	
Midlands—		
Small Rolled Bars	7 12 6 to 8 10 0	—
Billets and Sheet Bars	5 15 0 to 6 5 0	—
Galv. Sheets, f.o.b. L'pool	11 12 6	—
(2) Staffordshire Hoops	10 0 0	—
Angles	8 7 6	—
Joists	8 10 0	—
Tees	9 7 6	—
Bridge and Tank Plates	8 17 6	—
Boiler Plates	9 10 0	—

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14 f.o.b.	17/– to 17/3
Block Tin (Cash)	122 0 0
,, (three months)	123 10 0
Copper (cash)	43 17 6
,, (three months)	44 0 0
Spanish Lead (cash)	16 2 6
,, ,, (three months)	16 2 6
Spelter (cash)	14 10 0
,, (three months)	15 0 0
Manchester—	
Copper, Best Selected Ingots	47 10 0
,, Electrolytic	47 15 0
,, Strong Sheets	75 0 0
,, Tubes (Basis Price), lb.	0 0 11¼
Brass Tubes (Basis Price), lb.	0 0 10½
,, Condenser, lb.	0 1 0½
Lead English	17 7 6
,, Foreign	16 0 0
Spelter	14 15 0
Aluminium (per ton—raw ingot)	£95

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	2/6 per lb.	
Ferro Tungsten	2/3 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 5 6	7/–
,, ,, 6 p.c. to 8 p.c.	£22 10 0	7/–
,, ,, 8 p.c. to 10 p.c.	£22 0 0	7/–
,, ,, Specially Refined		
,, ,, Max. 2 p.c. carbon	£33 0 0	10/–
,, ,, ,, 1 p.c. carbon	£38 0 0	13/–
,, ,, ,, 0·70 p.c. carbon	£42 0 0	14/–
,, ,, ,, carbon free	11d. per lb.	
Metallic Chromium	2/7 per lb.	
Ferro Manganese (per ton)	£11 15 0 for home	
,, ,, ,,	£11 5 0 for export	
,, Silicon, 45 p.c. to 50 p.c.	£11 10 0 scale 5/– per unit	
,, ,, 75 p.c.	£18 0 0 scale 7/– per unit	
,, Vanadium	12/9 per lb.	
,, Molybdenum	4/2 per lb.	
,, Titanium (carbon free)	11d. per lb.	
Nickel (per ton)	£170 to £175	
Ferro Cobalt	9/6 per lb.	

FUELS.

SCOTLAND.

(*Prices not stable.*)

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	12/6
,, ,, Ell	13/6
,, ,, Splint	14/3 to 16/–
,, ,, Trebles	13/–
,, ,, Doubles	12/6
,, ,, Singles	10/9 to 11/–
Ayrshire—	
(f.o.b. Ports)—Steam	13/–
,, ,, Jewel	16/–
,, ,, Trebles	13/3
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	10/6 to 11/9
Screened Navigation	16/6 to 17/6
Trebles	13/6 to 15/–
Doubles	12/6 to 13/–
Singles	10/9
Lothians—	
(f.o.b. Leith)—Best Steam	11/–
Secondary Steam	10/9
Trebles	13/3
Doubles	12/6
Singles	11/–

ENGLAND.

(8) N.W. Coast—	
Steams	20/6 to 21/–
Household	32/6 to 53/6
Coke	21/– to 22/–
Northumberland—	
Best Steams	13/6
Second Steams	12/–
Steam Smalls	10/– to 10/6
Unscreened	12/6
Household	25/– to 37/–
Durham—	
Best Gas	14/9 to 15/–
Second	12/9 to 13/–
Household	25/– to 37/–
Foundry Coke	24/– to 26/–
Sheffield—	Inland.
Best Hand-picked Branch	25/6 to 27/–
Derbyshire Best Bright House	20/– to 22/6
Best House Coal	19/6 to 20/6
Screened House Coal	17/6 to 19/–
,, ,, Nuts	14/6 to 16/6
Yorkshire Hards	14/– to 15/6
Derbyshire Hards	14/– to 15/6
Rough Slacks	8/6 to 9/–
Nutty Slacks	6/6 to 7/6
Smalls	3/– to 5/–
Blast-furnace Coke (Inland)	12/6 on rail at ovens
Furnace and Foundry Coke (Export), f.o.b.	17/– to 18/6

(9) SOUTH WALES.

Cardiff—	
Steam Coals :	
Best Smokeless Large	20/–
Second Smokeless Large	18/9 to 19/9
Best Dry Large	18/6 to 18/9
Ordinary Dry Large	17/6 to 18/–
Best Black Vein Large	18/3 to 18/6
Western Valley Large	18/– to 18/3
Best Eastern Valley Large	17/9 to 18/–
Ordinary Eastern Valley Large	17/6 to 17/–
Best Steam Smalls	13/6 to 13/9
Ordinary Smalls	11/6 to 12/9
Washed Nuts	17/– to 21/–
No. 3 Rhondda Large	20/– to 20/6
,, ,, Smalls	15/6 to 16/–
No. 2 ,, Large	17/– to 17/3
,, ,, Through	16/– to 16/6
,, ,, Smalls	14/– to 14/3
Foundry Coke (Export)	27/6 to 37/–
Furnace Coke (Export)	21/– to 21/6
Patent Fuel	21/6
Pitwood (ex ship)	24/9 to 25/3
Swansea—	
Anthracite Coals :	
Best Big Vein Large	35/– to 37/6
Seconds	27/– to 31/6
Red Vein	23/6 to 27/–
Machine-made Cobbles	41/6 to 45/–
Nuts	40/– to 46/–
Beans	24/6 to 27/6
Peas	21/– to 21/6
Breaker Duff	10/– to 10/6
Rubbly Culm	10/6 to 10/9
Steam Coals :	
Large	19/6 to 21/6
Seconds	18/– to 19/6
Smalls	12/– to 13/–
Cargo Through	15/6 to 16/–

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate : Joists (minimum), 12/6 ; Ordinary Ship, Bridge, and Tank Plates and Sections, 10/– if home consumers confine purchases from associated British Steel Makers. (*e*) Delivered Black Country Stations.

French Engineering Notes.

(From our Correspondent in Paris.)

Steel Trade Disorganisation.

THE failure of the steel comptoirs has left some foreign producers with the impression that they are no longer tied to the bargain of leaving each member of the Cartel a monopoly of its own market, and as this is one of the principles of the Cartel itself, the fact that so much foreign steel should be offered in this country proves that the whole fabric of steel organisation is falling to the ground. It shows again that, while the Cartel stills exists pending negotiations for renewing the comptoirs, its influence has greatly declined, and it is by no means certain even that it will be able to enforce the conditions for a further restriction of steel output. In most countries that has become a necessity, but the idea of such a big reduction is not acceptable to French producers, who believe that they can dispose of more than the quota allotted to them, and the penalties they will incur for over-production are suggesting to them the desirability of some new combination. There is already talk of protection against the importation of Belgian steel. The only remedy obviously lies in keeping prices at a minimum level, which was to have been the task of the comptoirs, but all these efforts to give stability to the trade have failed. In view of the unsatisfactory outcome of interminable negotiations for placing the steel industry on a sound basis it would almost seem that nothing can be done so long as the production of steel remains greatly in excess of the consumption. There is so much rivalry over quotas that, even when agreement is arrived at, the feeling in some countries that they are deprived of a fair share of business is not conducive to a permanent understanding. The further reduction in output has failed to stimulate buying and prices are falling. In four months billets have dropped from £4 14s. per English ton f.o.b. Antwerp, to £3 12s., bars from £5 7s. 6d. to £4 4s., and joists of continental sections from £5 1s. 6d. to £3 18s. per ton. The steel production in France has declined slightly and exports are increasing. In August the output was 775,000 tons, and the exports amounted to 128,000 tons, as against 117,000 tons in July, the consignments being made chiefly to Great Britain and Germany. In the same way, there was a small falling off in pig iron output, but exports increased, the consignments to Great Britain amounting to 10,000 tons, as compared with 3000 tons in the previous month. Against these increased exports of raw iron and steel must be set off much larger imports of all kinds of steel products, principally from Germany.

The Plougastel Bridge.

A noteworthy reinforced concrete bridge has just been completed across the River Elorn at Plougastel, near Brest, and has undergone its trials preliminary to the official opening by the President of the Republic. Designed and constructed by Monsieur E. Freyssinet, who was responsible for many important reinforced concrete constructions in France, the Plougastel Bridge has three spans, each of 186 m. The total length with the approaches is 900 m., and the height 42·5 m. Three piers were first constructed with caissons and the timber falsework for each arch was erected on shore and floated out and placed in position on the pier abutments. A cable-way crossed the river from steel standards 55 m. high. The bridge carries two platforms, the lower one for the railway and the upper road for vehicular and passenger traffic, the total width being 8 m. The resistance tests were made with laden lorries representing a total load of more than 400 tons. At the centre of the spans there was a deflexion of 2·5 mm., which is much less than the permissible amount.

Smoke Consumption.

While so much is being done to suppress smoke in Paris, the discharge of volumes of black smoke from tugs passing along the Seine is regarded as an intolerable nuisance, and it is hoped that it may be overcome by an apparatus that has been fitted to some vessels, with, apparently, highly satisfactory results. It consists of two injectors sending jets of air and steam from the top of the door of the grate down diagonally to the back, and the mixture forms an incandescent screen of hot gases at a high temperature. The quantity of steam injected is about 2½ per cent. of the boiler's steam capacity; but it is not being used all the time. The injectors are regulated by the fire-door. When that is opened for firing, the injectors are working at full blast and the screen of hot gases is at its maximum and completely consumes the smoke passing through it. It is declared that tugs fitted with this apparatus show no trace of smoke from the chimney.

Railway Accident.

An unusual accident occurred outside the Gare St.-Lazare in Paris on Friday evening of last week. Owing to the narrowing of the railway at that point, and to the necessity of empty trains passing to and fro between the terminus and the Batignolles sheds, there is heavy traffic there. A train leaving Paris passed a caution signal and ran into an empty train that was proceeding in the same direction to the sheds. The first coach of the colliding train was telescoped and some of the passengers were badly injured. Almost at the same time, another empty train that was backing into the Gare St.-Lazare crashed into the passenger train, completing the wreckage, which obstructed most of the tracks. Four passengers were killed and five seriously injured.

The Claude Power Scheme.

Monsieur Georges Claude has made a beginning with his experiments in Cuba for recuperating energy from warm sea water by producing 20 kilowatts, with which he is said to have declared himself satisfied. It is a small beginning, but it is a tangible result, and the French hail it as pointing to vast developments in the future.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

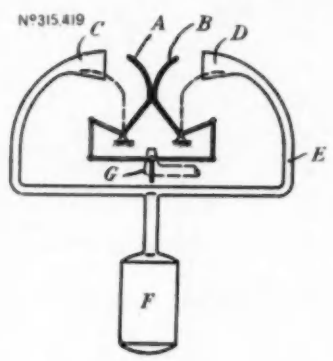
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

SWITCHGEAR.

315,419. July 12th, 1929.—ELECTRIC CIRCUIT BREAKER APPARATUS FOR LARGE OUTPUTS, Siemens-Schuckertwerke Aktiengesellschaft, of Berlin-Siemensstadt, Germany.

The two contacts of a switch are indicated by A and B, while C and D indicate a suction nozzle, connected by piping E, with a vacuum chamber for vacuum pump F. G indicates a further

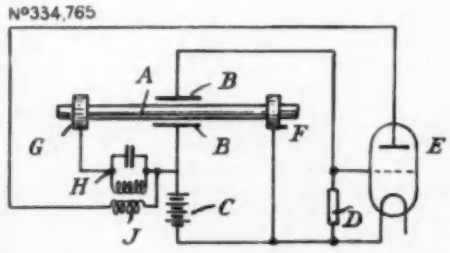


nozzle through which compressed air is supplied to the point of interruption. The vapours and gases, which are produced by the arc, are drawn away through the nozzles C and D, while by means of the current of air blown from the nozzle G the arc is forced outwards and broken off. The control of the suction and blast apparatuses can be adjusted to depend on the movement of the contacts.—*September 4th*, 1930.

TELEGRAPHS AND TELEPHONES.

334,765. October 23rd, 1929.—OSCILLATION GENERATING SYSTEMS, Telefunken Gesellschaft für drahtlose Telegraphie m.b.H., of 12–13, Hallesches Ufer, Berlin.

A rod A of dielectric material, for example, fused quartz, is used for producing the mechanical vibrations instead of a material possessing magnetic or piezo-electric properties. The centre portion of the rod A is arranged between two electrodes B, which are connected to each other through a direct-current source C and a resistance D. Parallel with the resistance is the grid cathode space of a thermionic valve E. The two ends of the rod project freely through two metal rings F G, of which one is connected to one pole of the battery C whilst the other G is connected to the other pole through an oscillation circuit H coupled to the anode of the valve by means of a coil J. The battery C also serves as the anode battery for the valve. As the rod oscillates mechanically in its fundamental wave, perceptible compressions and rarefactions will occur in the centre portion of the rod, and they will be accompanied by changes of dielectric constant corresponding to the volume change of the rod. The capacity between the electrodes

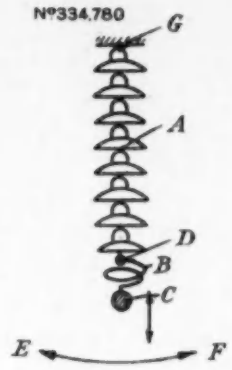


B is therefore varied in tune with the vibrations of the rod. Since the battery C maintains a constant voltage, the circuit consisting of the battery C, the resistance D, and the capacity B will be traversed by an alternating current which will produce a voltage drop in the resistance D, the frequency of the alternating current being equal to the oscillation frequency of the rod. This alternating voltage controls the anode current of the valve and thereby produces an alternating voltage in the oscillation circuit H and therefore an alternating voltage component between the rings F and G between which direct current from the battery C is supplied. The electrical field between these two electrodes runs partly through the dielectric material of the rod and produces a force which tends to draw the rod together. If the voltage between the rings F and G varies periodically the rod will be submitted to a constant contraction caused by the direct-current voltage and also to an alternating compressing and extending force which will maintain the mechanical vibrations if suitably phased. The required phase may be attained by adjusting the resistance D, the polarity of the coupling H J, and the tuning of the circuit H to obtain the necessary phase angle. The energy lost by internal friction in the rod is replaced by the valve and the rod vibrates as an undamped transmitter.—*September 11th*, 1930.

TRANSMISSION OF POWER.

334,780. November 7th, 1929.—DEVICE FOR OVERHEAD WIRES, Siemens-Schuckertwerke Aktiengesellschaft, of Berlin-Siemensstadt, Germany.

This invention relates to a fastening for high-tension lines on a bracket or supporting insulators, and is characterised by the fact that the points of suppression of the line in relation to the mast are movable vertically and are articulated and are under the influence of a spring, which is so arranged that mechanical oscillations of the line can pass away over the points of suspension. In the drawing A is an insulator chain with a spiral spring B, which carries the line C. The point of attachment D is formed as a hinge, so that small oscillations in the

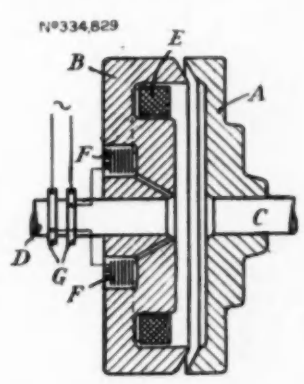


direction E and F are possible by rotation of the spring B about the point D. With larger oscillations the whole insulator chain can swing out about the point G, whilst the vertical movement is permitted by the spring B.—*September 11th*, 1930.

MACHINE TOOLS AND SHOP APPLIANCES.

334,829. March 13th, 1930.—MAGNETIC CLUTCHES, Siemens-Schuckertwerke Aktiengesellschaft, of Berlin-Siemensstadt, Germany.

Electro-magnetic clutches are provided with a magnet winding, which has to be fed with direct current. In consequence of the increasing use of alternating current, the field of application of such clutches is becoming smaller. The object of the invention is to make it possible to use electro-magnetic clutches for working with alternating current, so that they may be connected at the place where they are to be used to any available

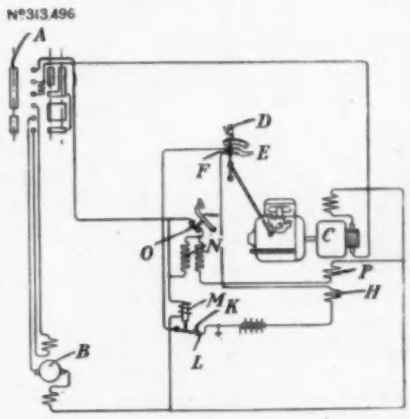


source of alternating current. The electro-magnetic clutch described in this specification consists of two parts A and B, mounted on shafts C and D respectively. The part B carries a magnet winding E. The ends of this magnet winding are connected by leads with a rectifier F, arranged in four groups in the known Graetz circuit. The rectifier is constructed as a dry plate rectifier, the cells of which, divided into the four groups, are disposed in recesses in the front face of the part B. A pair of wires lead from the rectifier to slip rings G, which are mounted on the shaft D and serve to supply the alternating current.—*September 11th*, 1930.

MOTOR CARS AND ROAD TRAFFIC.

313,496. June 11th, 1929.—ELECTROMECHANICALLY-DRIVEN VEHICLES, *The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C. 2.*

This invention relates to electrically driven vehicles of the type having an internal combustion engine or other prime mover arranged to drive a generator to which the driving motors of the vehicle are connected. The object is to provide an arrangement in an electric vehicle of this character which will considerably increase the rate of acceleration of the vehicle in starting, and



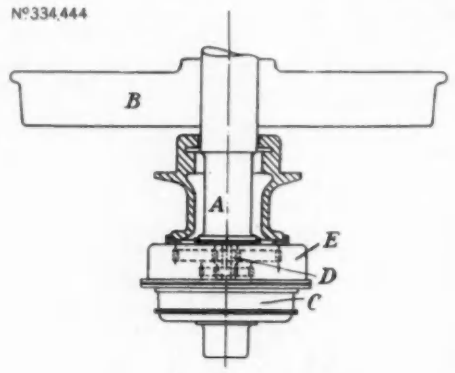
thereby increase the average speed of the vehicle when it is being operated under conditions requiring frequent stops. After the engine has started the controller is moved to position A, which connects the driving motor B directly to the generator C. The lever D is then moved to open the throttle, which increases the speed of the engine and at the same time closes the contacts E and F so as to energise the auxiliary winding H of the generator. This causes the voltage of the generator to build up rapidly, and the driving motor B to accelerate the vehicle at a corre-

spondingly rapid rate. When the vehicle reaches normal running speed the contacts K and L of the relay are opened by the coil M, which de-energises the auxiliary winding H so that it will not interfere with the normal operation of the vehicle. Upon bringing the vehicle to a stop, the lever D is moved to close the throttle and to move the contact F out of engagement with the contacts E and open the circuit to the auxiliary winding H, which will also be open at this time because the contact K will have been raised by the coil M. As the vehicle is brought to rest the voltage of the generator will be reduced so that the coil M will be only slightly energised, which will permit the contact K to drop into engagement with the contact L. This will not, however, energise the auxiliary winding H because the contacts E will be opened by the previous movement of the lever D to close the throttle, so that when the vehicle is brought to rest heavy short-circuit current through the motor B is avoided without the necessity of disconnecting it from the generator. A simple arrangement is therefore provided for increasing the acceleration of an electrically driven vehicle which will not interfere with its normal operation or overload the engine at idling speed when the vehicle is at rest. In order to provide for decreasing the excitation of the generator when it is heavily loaded, a resistance N is connected across the switch O and a foot pedal is provided for operating the switch so as to insert resistance in the winding P.—*September 11th*, 1930.

LIGHTING AND HEATING.

334,444. November 6th, 1929.—Train-lighting Electric Generators, C. Lorenz Aktiengesellschaft, of 1, Lorenzweg, Berlin-Tempelhof, Germany.

In accordance with this invention a medium frequency alternating current machine is used for lighting trains. The stump A of the axle of the wheel B is coupled with the rotor of the medium frequency machine C, through a train of gears D housed in a casing E secured at the extremity of the axle stump.

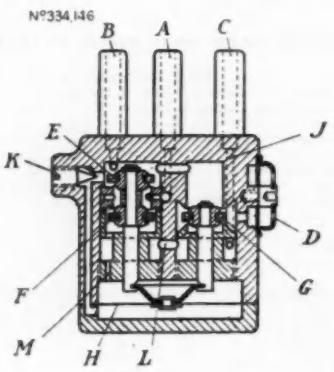


The gear train serves for increasing the speed of the machine C in relation to that of the vehicle wheel B, so that this machine will be able to supply current for lighting purposes even at a relatively low travelling speed. The space required by the medium frequency machine is materially less then that of the continuous current machine, so that the medium frequency machine can be arranged at the extremity of the bushing of the axle.—*September 4th*, 1930.

MISCELLANEOUS.

334,146. December 6th, 1929.—Apparatus for Automatically Establishing Alternate Vacuum and Atmospheric Pressure in Two Conduits, Sornska Aktiebolaget Gas-assumulator, Lidingo-Stockholm, Sweden.

This device is primarily intended for use in connection with milking machines, but might be applied to other purposes. The branch A is connected with a vacuum pump, while B and C are branches for two pipe lines, while D is an inlet for atmospheric air. There are a double-beat valve E F and a single-



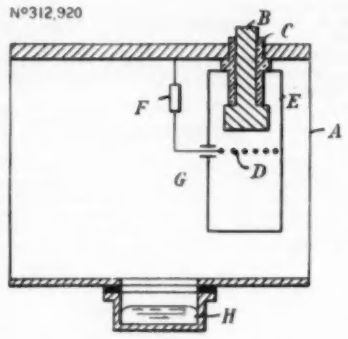
beat valve G, in separate chambers, both connected with a diaphragm H. With the valves in the top position, the vacuum is transmitted from A over the valve E to the branch B, and air passes from D under the valve G and up the passage J to the branch C. At the same time the vacuum leaks past the needle valve K to the space below the diaphragm H and air passes through the passages L and M to the space above the diaphragm which is depressed, the valves are lowered, and the connections are reversed.—*August 28th*, 1930.

312,652. May 28th, 1929.—Electric Condensers, Elektrizitäts-Aktiengesellschaft Hydrawerk, of Windscheidstrasse 18, Berlin-Charlottenburg, Germany.

This invention relates to improvements to electric condensers, and in particular to a method of heating assembled condensers during the drying, evacuating, and impregnating process. The processes of drying, evacuation and impregnation of assembled electric condensers can be carried out under favourable conditions by bringing the condenser under the influence of a high-frequency field, and thereby inducing eddy currents in the metallic elements, with the result that the heating takes place within the condenser.—*August 28th*, 1930.

312,920. May 29th, 1929.—Mercury-vapour Rectifiers, Maschinenfabrik Oerlikon, of Oerlikon, near Zürich, Switzerland.

This invention relates to improvements in metal vapour discharge tubes, especially mercury-vapour rectifiers. More particularly the invention relates to an arrangement for preventing back ignition in metal vapour discharge tubes having cathodes insulated from the discharge tube. A indicates the discharge tube and B an anode which is insulated from the tube A by an insulator C. E is an anode sleeve which is arranged to protect the anode against the ascending metal vapours. D is a metallic grid, which is inserted in an insulated manner in the anode sleeve E at a distance of some millimetres from the anode head and is



connected with the casing of the tube A through a resistance F, the lead out from the grid being insulated from the sleeve E at G. The value of the resistance F depends on numerous factors and must be determined for each particular case. It should, however, be sufficiently low to allow the flow of a current of about 1 milliamp. between the grid D and the casing of the tube A. H is the cathode mounted on the rectifier tube, but insulated therefrom.—*August 29th*, 1930.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

Institute of Metals: Sheffield Local Section.—In the Mappin Hall, Non-ferrous Section of the Applied Science Department of the University, St. George's-square. Sixth "Sorby" Lecture, "Some Observations on the Wire Drawing Process," by Professor F. C. Thompson. 7.30 p.m.

Junior Institution of Engineers.—39, Victoria-street, S.W. 1. "The Refining of Cane Sugar," by Mr. S. Dunlop. 7.30 p.m.

Keighley Association of Engineers.—Queen's Hotel, Keighley. "Materials Used in Modern Engineering," by Mr. T. H. Turner. 7.30 p.m.

Manchester Association of Engineers.—At the Engineers' Club, Albert-square, Manchester. Presidential address, "Thermal Progress," by Mr. G. E. Windeler. 7.15 p.m.

Railway Club.—57, Fetter-lane, Fleet-street, London, E.C. 4. "Notes on Time Tables and Train Running," by Mr. C. J. Allen. 7.30 p.m.

TO-DAY and SATURDAY, OCTOBER 11th.

Institute of Patentees (Inc.) International Exhibition of Inventions.—Central Hall, Westminster, S.W. 1. Daily, 10 a.m. to 10 p.m.

SATURDAY, OCTOBER 11th.

Institute of British Foundrymen: Lancashire Branch, Burnley Section.—Technical College, Omerod-road, Burnley. "Belgian Moulding Sands in the Ironfoundry," by Mr. F. Griffiths.

MONDAY, OCTOBER 13th.

Institute of Transport.—Institution of Electrical Engineers, Victoria Embankment, W.C. 2. Opening address by the President, the Hon. Sir Arthur Stanley. 5.30 p.m.

TUESDAY, OCTOBER 14th.

Institute of Marine Engineers.—The Minories, London, E.C. 3. "The Design and Manufacture of Marine Auxiliary Oil Engines," by Mr. O. Wans. 6 p.m.

Institute of Metals: North-East Coast Local Section.—In the Electrical Engineering Lecture Theatre, Armstrong College, Newcastle-on-Tyne. Chairman's address. Mr. C. Gresty. 7.30 p.m.

Manchester Geological and Mining Society.—Queen's Chambers, 5, John Dalton-street, Manchester. Annual general meeting. "Correlation of the Middle Coal Measures of Manchester," by Dr. W. B. Wright. 4 p.m. The Council will meet at 3 p.m.

Manchester Geological and Mining Society.—Engineers' Club, Albert-square, Manchester. Annual dinner. 6.15 p.m.

WEDNESDAY, OCTOBER 15th.

Electroplaters' and Depositors' Technical Society.—Northampton Institute, Clerkenwell, E.C. 1. "Practical Difficulties in the Electro-deposition of Chromium," by J. W. Cuthbertson. 8.15 p.m.

Institution of Civil Engineers: Manchester and District Association.—At 36, George-street. Mr. W. F. H. Creber will deliver his address. 6.45 p.m.

Institution of Electrical Engineers: South Midland Centre.—Grand Hotel, Birmingham. Faraday Lecture, "The Birth of Electrical Engineering," by Professor W. Cramp. 7 p.m.

Institution of Engineering Inspection.—Rooms of the Royal Society of Arts, John-street, W.C. 2. "A Practical Application of British Standard Limits and Fits to Locomotive Construction," by Mr. E. Harle. 5.30 p.m.

Newcomen Society.—Science Museum (Demonstration Room, Ground Floor), South Kensington, S.W. 7. "Enquiry into the Origins of the Windmill," by Mr. H. P. Vowles. 5.30 p.m.

Society of Glass Technology.—In the Applied Science Department, the University, St. George's-square, Sheffield. To receive and discuss the following papers: "The Effect of Re-melting on the Properties of Glass," by Professor W. E. S. Turner; "The Thermal Endurance of Glass: An Examination of the Method of W. M. Hampton and C. E. Gould," by Mr. W. J. A. Warren; "International Co-operation and Standardisation Related to Glass, Refractories and Furnaces," a general discussion. The discussion will be introduced by a report on the joint meeting of Technical Committees of the Society of Glass Technology and the Deutsche Glastechnische Gesellschaft. 2 p.m.

THURSDAY, OCTOBER 16th.

Institution of Mechanical Engineers.—Connaught Rooms, Great Queen-street, London. "Charter" dinner. 6.45 p.m. for 7.15 p.m.

Institution of Mechanical Engineers: North-Western Branch.—Engineers' Club, Albert-square, Manchester. "The Effect of Low Temperature on the Shock-resisting Properties of New Wrought Iron Chain," by Dr. Gough and Mr. Murphy. 7.15 p.m.

Institution of Welding Engineers.—At the Institution of Mechanical Engineers, Storey's-gate, St. James's Park, London, S.W. 1. "The Replacement of Castings by Weldings," by Mr. P. L. Roberts. 7.45 p.m.

FRIDAY, OCTOBER 17th.

Faraday House Old Students' Association.—Savoy Hotel, London, W.C. 2. Twenty-second annual dinner.

Institution of Mechanical Engineers.—Storey's-gate, St. James's Park, London, S.W. 1. Presidential address by Mr. L. St. L. Pendred. 6 p.m.

Institution of Municipal and County Engineers: North-Western District.—Meeting at Liverpool. Join motor omnibuses at St. George's Hall Plateau (opposite North-Western Hotel). 2 p.m.

Junior Institution of Engineers.—39, Victoria-street, S.W. 1. "The London Automatic Telephone System," by Mr. T. H. Flowers. 7.30 p.m.

West of Scotland Iron and Steel Institute.—Royal Technical College, George-street, Glasgow. Presidential address, by Mr. Robert Hamilton. Adjourned autumn meeting. The Iron and Steel Institute. Discussion on the following papers: "What Reasons Compelled the Prague Ironworks to Introduce Thin-walled Blast-furnaces?" by Mr. J. Sarek; "Open-hearth Furnace Construction and Practice," by Mr. H. C. Wood. 7.15 p.m.

MONDAY, OCTOBER 20th.

Institution of Mechanical Engineers: Graduates' Section.—Storey's-gate, St. James's Park, London, S.W. 1. "Mass Production of Tin Containers," by Mr. A. E. Hamblin. 6.45 p.m.

TUESDAY, OCTOBER 21st.

Society of Engineers.—Holborn Restaurant. Dinner in honour of Miss Amy Johnson's achievement in flying alone to Australia. 7 p.m.

WEDNESDAY, OCTOBER 22nd.

Liverpool Engineering Society.—9, The Temple, 24, Dale-street, Liverpool. "Notes on Surveys of Ships," by Mr. J. L. Adam. 6.30 p.m.

WEDNESDAY and THURSDAY, OCTOBER 22nd and 23rd.

Institute of Fuel.—October Conference. In the Incorporated Accountants Hall, Victoria Embankment, London, W.C. (close to the Temple Station of the District Railway). Wednesday, presidential address by Sir David Milne-Watson. 11 a.m. "The Industrial Uses of Fuel Oil," by Mr. J. Lubbock; "The Use of Coke Breeze for Industrial Purposes," by Dr. E. W. Smith. 2.15 p.m. Annual dinner and dance to be held at the Connaught Rooms, Great Queen-street, London, W.C. Reception at 6.45 p.m. Thursday, morning and afternoon sessions, commencing at 10.45 a.m. The whole day will be devoted to a symposium on the subject of "Fuel Problems in the Mercantile Marine," to which the undermentioned authors will contribute an account of their experiences in the use for marine purposes of the various types of fuel, and their applications, which have come under the respective author's observations. The list of authors is as follows:—Mr. Sterry B. Freeman, Dr. W. W. M. Meijer, Mr. W. J. Muller, Mr. W. L. Roxburgh. At the presentation of the papers a general collective report upon them will be given by Engineer Vice-Admiral Sir Robert B. Dixon and Major W. Gregson.

FRIDAY, OCTOBER 24th.

Institution of Mechanical Engineers.—Storey's-gate, St. James's Park, London, S.W. 1. Informal meeting. Discussion on "What are the Desirable Objectives of the Age of Power?" to be introduced by Mr. J. L. Hodgson. 7 p.m.

Junior Institution of Engineers.—39, Victoria-street, S.W. 1. "Bitumen Emulsions, with Particular Reference to Their Use on Indian Roads," by Mr. A. P. Morris. 7.30 p.m.

MONDAY, OCTOBER 27th.

Institution of Electrical Engineers.—Victoria Embankment, London, W.C. 2. Informal meeting. Discussion on "The Link Between Sales, Manufacture and Research," opened by Mr. C. C. Paterson. 7 p.m.

TUESDAY, OCTOBER 28th.

Institute of Metals: Swansea Local Section.—In the Y.M.C.A., Swansea. "Impurities in Copper," by Dr. W. Rosenhain, F.R.S. 6.15 p.m.

FRIDAY, OCTOBER 31st.

Junior Institution of Engineers.—39, Victoria-street, London, S.W. 1. Informal meeting. "The Two-stroke Engine," by Mr. E. T. Westbury. 7.30 p.m.

Overhead Lines Association.—Annual conversazione.

WEDNESDAY, NOVEMBER 5th.

Institution of Sanitary Engineers.—Holborn Restaurant, London, W.C. Annual dinner. 7 p.m.

Liverpool Engineering Society.—9, The Temple, 24, Dale street, Liverpool. "The Application of Electro-deposited Metals to Marine Engineering," by Mr. C. H. Faris. 6.30 p.m.

FRIDAY, NOVEMBER 7th.

Institution of Mechanical Engineers.—Storey's-gate, St. James's Park, London, S.W. 1. Thomas Hawksley Lecture, "The Machinery of the Earth," by Professor J. W. Gregory, F.R.S. 6 p.m.

Costing: An Aid to Management.—The Master Cutler-elect, Mr. P. B. Brown, M. Inst. C.E., will preside over a meeting of works directors and business executives at the Cutlers' Hall, Sheffield, on Friday, October 24th, at 2.30 p.m., when a paper on "Why Cost Accounting is Vital to Efficient Management," will be read and discussed. This meeting, which is open to all who are interested, is part of the programme of the Ninth National Cost Conference, which will be held in Sheffield on October 24th and 25th, under the auspices of the Institute of Cost and Works Accountants.